INTRODUCTION

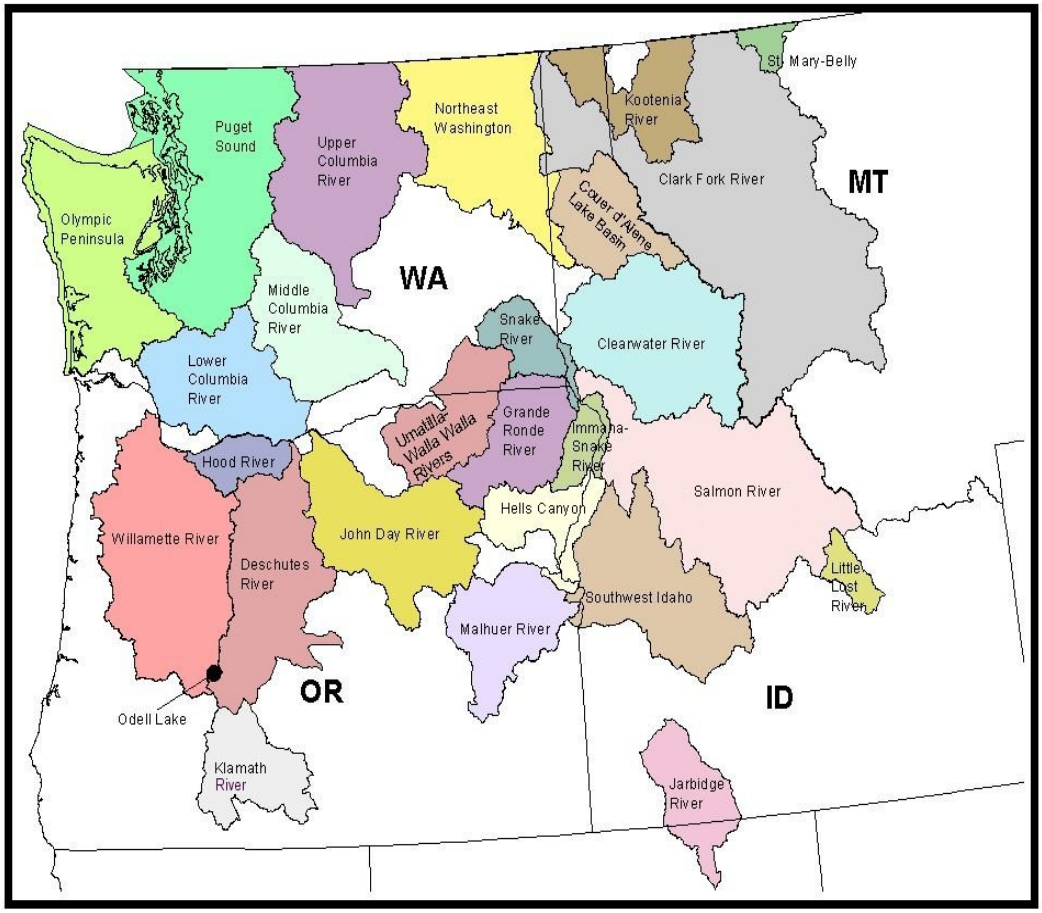
The Draft Bull Trout Recovery Plan (USFWS 2002) includes a hierarchical approach to organizing units of conservation, from the broad scale of recovery units, to core areas, to the finer scale of local populations. A core area is considered to be the closest approximation of a biologically functioning unit for bull trout, containing all the necessary elements for long-term survival. These and other terms are defined later in the Strategy For Recovery section of this report, and a detailed discussion of the logic behind this approach and glossary definitions can be found in Chapter 1 of the Draft Bull Trout Recovery Plan (USFWS 2002).

Recovery Unit Designation

The Saint Mary - Belly River Recovery Unit includes the only population(s) of bull trout east of the Continental Divide in the United States (Figure 1), and was designated by the U.S. Fish and Wildlife Service as one of five distinct population segments within the range of bull trout.

A complete analysis of bull trout distribution and abundance is provided in the chapter that follows. However, it is important for the reader to be familiarized up front with the organization of proposed core areas and local populations. Core area designation was based on the documented historical distribution of bull trout, supplemented by more recent research findings. Most of the interconnected Saint Mary River watershed in the United States, extending downstream to the international border, was considered one primary core area (Figure 2). Exceptions were designated as separate secondary core areas, in the watersheds of Slide Lake, Red Eagle Lake, upper Lee Creek, and Cracker Lake (Figure 2). In all four cases, determinations were based on reproductive isolation of bull trout present in these systems. A second primary core area was designated in the interconnected Belly River drainage and North Fork Belly River, the headwaters of which are in the United States. (Figure 2).

Figure 1. Bull trout recovery units in the United States. The Saint Mary - Belly River Recovery Unit is in the upper right corner.

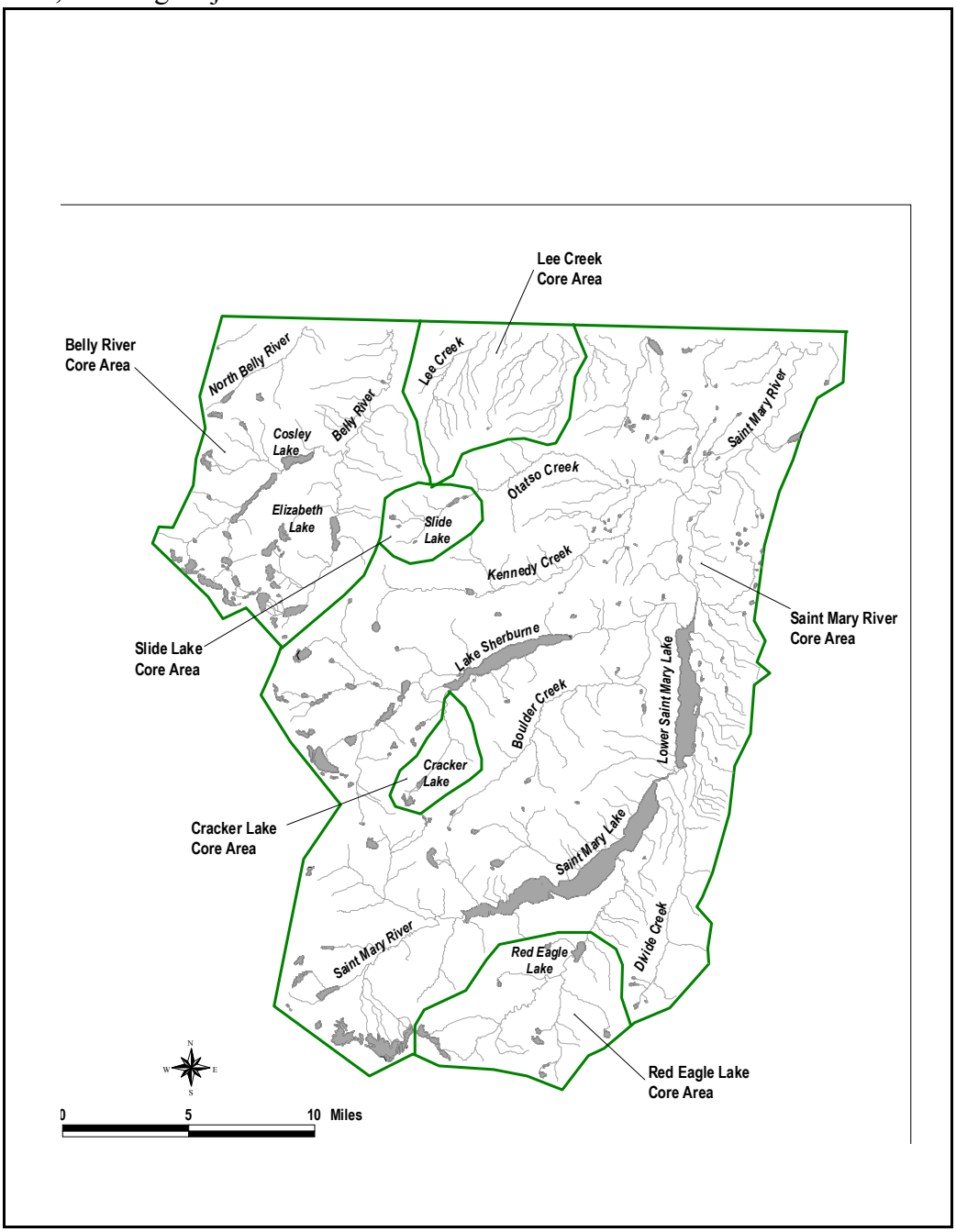


Secondary core areas are generally based in smaller watersheds and typically contain migratory populations of bull trout that have become naturally isolated, with restricted upstream spawning and rearing habitat. Secondary core areas each include one identified local population of bull trout and generally do not contain habitat of sufficient size and complexity to accommodate the multiple local populations found in primary core areas.

Thomas *et al.* (2001) analyzed genetic variation in bull trout, using DNA samples, from major drainages across Alberta, Canada. Included were samples

from Cracker, Red Eagle, and Slide lakes in the Saint Mary River drainage in the United States and from the Belly and Waterton rivers just north of the

Figure 2. Detailed map of the Saint Mary - Belly River Bull Trout Recovery Unit, showing major watersheds and core areas in the United States.



international border. They concluded that the Belly and Saint Mary River samples clustered closely together, but were genetically distinct from populations of bull trout within other portions of the South Saskatchewan River drainage in Alberta, Canada (Thomas *et al.* 2001). They suggest that during evolution, selection has occurred within ecological zones with similar adaptive pressures, resulting in distribution of bull trout with similar genotypes over large geographical regions. These data may suggest that populations of bull trout in the Saint Mary and Belly rivers have been reproductively isolated from downstream waters for a long time, and functional connectivity within the headwaters of the Oldman River drainage may have been weak to nonexistent in the past century.

A genetic analysis of bull trout from five isolated headwater lakes in the Columbia River drainage west of the continental divide in Glacier National Park was conducted by Spruell *et al.* (2002). These results were contrasted with results from collections in the Otatso, Boulder, and Kennedy creek watersheds of the Saint Mary River drainage. Spruell *et al.* (2002) concluded that despite physical separation of as little as about 30 kilometers (roughly 20 miles) across the continental divide, there were consistent genetic differences between populations from the Saskatchewan River (east) and Columbia River (west) headwaters, including several instances of unique alleles that were found on only one side or the other. They suggest that bull trout in the Saint Mary River drainage should continue to be managed independently for recovery purposes, as is legally recognized by their listing as a separate distinct population segment under the United States Endangered Species Act (Spruell *et al.* 2002).

The mainstem Belly River originates at the Continental Divide, in Glacier National Park at Helen Lake, flowing about 5 kilometers (3 miles) north into Elizabeth Lake, and then approximately 15 kilometers (6 miles) north into Alberta (Figure 3). The migratory fluvial bull trout population of the Belly River can be considered inhabiting as close to an unaltered physical environment as is likely to exist in the headwaters of the Oldman River basin (Clayton 2001). Genetic evaluation conducted of lake trout from across Canada and the northern U.S. included samples from Cosley and Waterton Lakes, in the Belly River and Waterton River drainages, respectively. The study concluded that the lake trout

inthese waters are native and represent a unique genetic haplotype that persisted through the ice age in a nearby refugium (Wilson and Hebert 1998). Major

barriers to upstream fish migration exist below Glenns and Cosley lakes at Gros Ventres Falls (Figure 3), and below Helen and Elizabeth lakes at Dawn Mist Falls, and isolate them from most of the downstream Belly River system.

Geographic Description

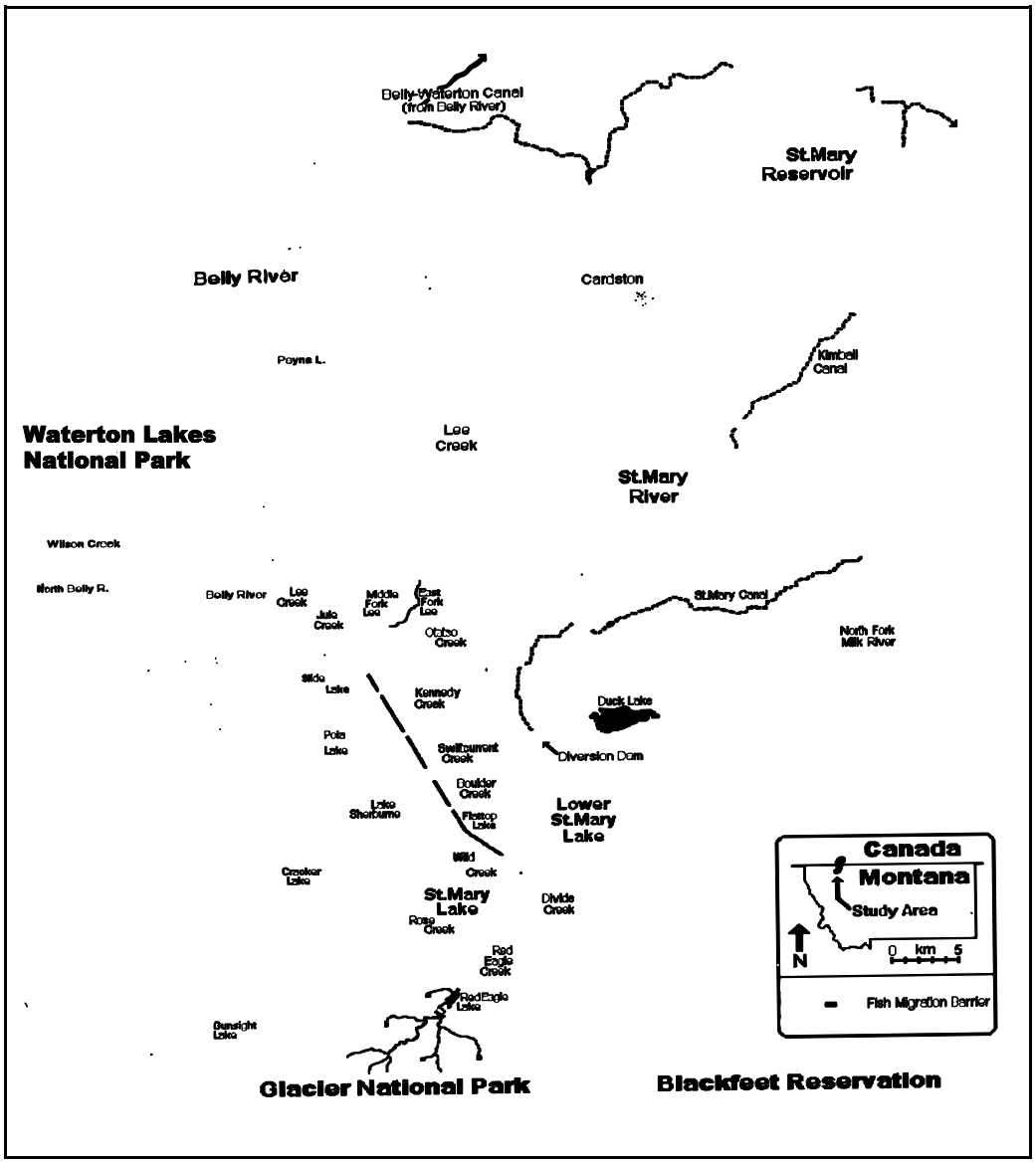
The interjurisdictional nature of the Saint Mary River and Belly River watersheds makes coordination of bull trout restoration efforts especially critical. Major ownerships include Glacier National Park and the Blackfeet Nation in the United States, the Province of Alberta, Waterton Lakes National Park, the Blood Tribe, and various private entities in Canada. Without cooperation of landowners and other government agencies that dictate land and water policy, restoration of bull trout populations, particularly migratory life history forms, cannot succeed.

The topography of most of this region of the east slopes of the Rocky Mountains consists of very steep, unstable, often unvegetated slopes. Erratic weather patterns and high winds are common and storms occur frequently. Spectacular mountain lakes and lush green valleys mark the watersheds. In total, these elements combine to comprise the spectacular scenery and rugged mountain vistas that led to these areas being set aside as national parks on both sides of the international border.

In bull trout habitat of a typical upper Columbia River watershed, such as occurs in the Flathead River basin on the west side of Glacier National Park, streams usually emerge from mountain peaks through a gradual transition of forested areas to the valley bottom. On the east front of the Rockies, in streams like the Saint Mary and Belly River, the transition from cold water to cool and warm water habitat is often much more abrupt. The area has been heavily influenced by glacial activity from both continental ice masses and alpine glaciation and much of the forested habitat exists under harsh conditions. Trees are small and slow-growing. Streams typically crash down steep headwater

chutes from alpine basins, depositing large amounts of bedload at the base of the mountain. The waters warm rapidly and channels assume a meandering configuration typical of low-gradient prairie streams.

Figure 3. Schematic map of the Saint Mary River and Belly River watersheds in the United States and Canada.



The Saint Mary River and Belly River basins remain sparsely populated. Fewer than a thousand people live year-round within the drainage in Montana, many of those clustered around Glacier National Park Fewer than 10,000 people live in all of Glacier County (U.S. Census Bureau 2000). The two largest towns are Browning (population 1,200), which is the location of Blackfeet Tribal Headquarters, and Cut Bank (population 3,500), located just off the Reservation. Both of those towns are located outside the Saint Mary River drainage in the headwaters of the Missouri River.

Saint Mary River

The Saint Mary River watershed heads in steep, glaciated valleys in Glacier National Park. It flows northward through the glaciated trough of Saint Mary Lake and Lower Saint Mary Lake and across the northwest corner of the Blackfeet Reservation before crossing the international border into Alberta, Canada (Figure 3). The Saint Mary River in Canada flows northeast through southwest Alberta and enters the Oldman River a few kilometers upstream from Lethbridge, Alberta.

Gunsight Lake, the source of the Saint Mary River, was historically fishless but now contains mixed stocks of introduced cutthroat trout, rainbow trout, and brook trout. Saint Mary Falls, located on the Saint Mary River about 1 kilometer (0.6 miles) upstream from the head of Saint Mary Lake, is a barrier to upstream migration, and bull trout are not found in the Saint Mary River upstream from Saint Mary Falls.

The famed “Going To The Sun” highway begins at the east entrance to Glacier National Park, at the town of Saint Mary. The highway follows the northwest shore of Saint Mary Lake along its entire 15 kilometer (9 mile) length, before continuing west to climb the pass. The Saint Mary River flows out of Saint Mary Lake onto the Blackfeet Reservation and continues northeast for about 2 kilometers (1.2 miles) before entering Lower Saint Mary Lake (9 kilometers, or 6 miles long). U.S. Highway 89 skirts the east shore of Lower Saint Mary Lake.

Downstream from Lower Saint Mary Lake, the river meanders northerly about 25 kilometers (15.5 miles) to the international border, then continues north through shrub-grassland habitat in southwest Alberta for about 55 kilometers (34 miles) to Saint Mary Reservoir. The reach of the Saint Mary River that flows from the reservoir joins the Oldman River about 8 kilometers (5 miles) upstream from Lethbridge, Alberta.

Several major tributaries head in Glacier National Park and flow through mostly steep forested habitats to enter the Saint Mary River or its lakes (Figure 2). Although each of those tributaries differs in physical characteristics that may be important to fish (Mogen and Kaeding 2001), all have in common the frequent occurrence of natural year-round or seasonal barriers to the movements of fish. The characteristics of the basin and its tributaries are described in the following paragraphs, in progression from the headwaters downstream, and are largely taken from Mogen and Kaeding (2001) and Morton (1961).

Red Eagle Creek

Red Eagle Creek is a large tributary to the south shore of Saint Mary Lake originating from glacial melt near the Continental Divide and flowing northeast about 13 kilometers (8 miles), over a series of waterfalls, to Red Eagle Lake. The standing Montana State record cutthroat trout, weighing 7.3 kilograms (16 pounds), was taken from Red Eagle Lake in 1955 (Montana Fish Wildlife and Parks 2002). From Red Eagle Lake, the creek flows northeast about 8 kilometers (5 miles) to the southeast shore of Saint Mary Lake. There is speculation that the lower reaches of Red Eagle Creek could be (or was historically) a potential bull trout spawning stream for Saint Mary Lake fish, and there are historical reports of anglers catching large bull trout in lower Red Eagle Creek.

Wild Creek

Wild Creek, a small tributary entering the Saint Mary River between the lakes from the north, originates as snowmelt and flows east about 7 kilometers (4 miles), cascading over cobble-boulder substrates and abundant woody debris. Wild Creek is not likely to be used by migratory bull trout, but does contain the

only known unhybridized population of westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in the Saint Mary drainage in Montana (Mogen and Kaeding 2001).

Divide Creek

Divide Creek originates at a cluster of small alpine lakes in Glacier National Park and flows northeast about 15 kilometers (9 miles) before entering the Saint Mary River from the south, between the Saint Mary lakes. The lower reaches of Divide Creek form the boundary between the Blackfeet Reservation and Glacier National Park. The creek contains much woody debris and the substrate is dominated by cobble and boulders (Mogen and Kaeding 2001). About 11 kilometers (7 miles) upstream from the Divide Creek confluence with the Saint Mary River, Divide Creek flows become entirely subsurface for a distance of about 200 meters (650 feet) during the seasonal low-flow period (Mogen and Kaeding 2001). Downstream from that location, Divide Creek emerges as groundwater upwellings along a 1.5 kilometer (1 mile) reach of gravel-cobble alluvium. Similar sites with groundwater upwelling have been shown to provide high quality potential spawning habitat and are frequently sought out by spawning bull trout (Baxter and Hauer 2000).

The lower reaches of Divide Creek are highly unstable. Encroachment of Glacier National Park facilities and private development in the Divide Creek floodplain at the village of Saint Mary has resulted in extensive damage to both property and the stream channel in the past, during and after multiple flood events (Smillie and Ellerbroek 1991). Use of heavy equipment to remove alluvium from the channel, thereby maintaining the current channel configuration in order to reduce flooding, has been a regular occurrence and may contribute to the instability of the Divide Creek system. A flood hazard evaluation of this stream, conducted by a technical team from the National Park Service in 1991, concluded the problem would continue due to unlimited potential for mass wasting. A sheet pile metal flood wall was erected to partially protect Glacier National Park facilities, but the report cautioned that was not a permanent solution and further noted that the flood wall increased flooding potential downstream. The analysis recommended structural improvements and expansion of the flood wall, annual

fall removal of channel sediments, and development of a flood contingency plan (Smillie and Ellerbroek 1991).

In 1992, Glacier National Park conducted a value analysis of the various potential remedies to the instability of Divide Creek; including maintaining the status quo, implementing a variety of modifications to the Divide Creek channel, and options to relocate National Park Service facilities (GNP 1992). Ecological evaluation strongly favored relocation, and aquatic ecologist Leo Marnell (now chief scientist for Glacier National Park) stated (GNP 1992):

> "My conclusion is that an impoverished aquatic community is likely to exist in the affected section of Divide Creek until such time as bulldozer operations and related disturbances cease. Any associated effects on the fishery in Lower Saint Mary Lake, admittedly a speculative issue, will likewise persist for as long as Divide Creek continues to be manipulated for purposes of flood protection."

Final value rankings favored variations of the relocation option, but to date little progress has been made in implementing solutions, due largely to financial considerations.

Swiftcurrent Creek and Lake Sherburne

Swiftcurrent Creek originates at a series of lakes in Glacier National Park, near the Continental Divide, and flows into Lower Saint Mary Lake near its outlet. Much of the headwaters of Swiftcurrent Creek consists of chains of lakes connected by stream channel. According to Morton (1961) all these lakes were historically fishless, with the possible exception of sculpins (*Cottus spp.*). The presence of Swiftcurrent Falls (about 20 meters, or 66 feet high) at the outlet of the chain of lakes was likely responsible for the fishless condition of the upper basin.

About 1920, Swiftcurrent Creek was impounded by completion of an earth fill dam, 29 meters (94 feet) high and 330 meters (1,086 feet) long, just outside the current Park boundary which formed Lake Sherburne (Figure 3). That reservoir has a maximum surface area of 648 hectares (1,600 acres) and storage capacity of nearly 84 million cubic meters (68,080 acre feet) (Mogen and Kaeding

2001). At full pool elevation (1,459.3 meters, or 4,788 feet) the reservoir backs up water to within a few hundred meters of the base of Swiftcurrent Falls. Mean monthly inflows to the reservoir (1955 to 1992) range from 1.2 cubic meters per second (42 cubic feet per second) during February, to 20.2 cubic meters per second (720 cubic feet per second) during June. The Lake Sherburne outlet works has a maximum capacity to discharge 59.5 cubic meters per second (2,100 cubic feet per second) at full reservoir pool elevation, and the maximum combined discharge of the spillway and outlet works is 113.3 cubic meters per second (4,000 cubic feet per second) (USBR 2001). The reservoir can be drawn down a maximum of 18 meters (59 feet), to 1,441 meters (4,729 feet) above sea level, leaving a conservation pool of only 3,061 acre-feet (4.5 percent of full pool).

The irrigation use of waters of the Saint Mary and Milk rivers are divided between Canada and the United States by the 1909 Boundary Waters Treaty, in accordance with the Order of the International Joint Commission dated October 4, 1921 (USBR 2001). The United States utilizes its entitlement to Saint Mary River water by regulating flows through storage in Lake Sherburne and diverting Saint Mary River flows through the Saint Mary Canal to the Milk River basin. There are no agreements for reservoir releases specifically for fish, wildlife, or recreation purposes and no minimum release requirement (USBR 2001). All stored water is dedicated for irrigation purposes, and other uses are considered incidental.

The U.S. Bureau of Reclamation implements the following basic criteria for operations of Lake Sherburne (USBR 2001). Near the end of spring runoff, discharge is regulated based on snow measurements and inflow forecasts to ensure filling the reservoir to full pool elevation. Every effort is made to prevent spilling, while assuring a full pool. About 3 meters (10 feet) of space is maintained in the pool, by releasing excess inflow, until the final stages of spring runoff.

The U.S. Bureau of Reclamation produces an annual summary of operations, which includes an operating plan for the reservoir and the Milk River Irrigation Project. The plan includes an assessment of hydrologic and climatic conditions in the basin and an estimated operating plan for the coming water year (October to September). U.S. Geological Survey

stream gaging stations in the system are located in Swiftcurrent Creek above the reservoir and below the dam (1912 to present); in the Saint Mary River, above the diversion, at the outlet of Lower Saint Mary Lake (1901 to present with some gaps); and in the Saint Mary River at the international border (1902 to present) (USGS 2002). Additional data are available for Lake Sherburne elevations (1924 to present) and for Saint Mary canal flows (1918 to present).

The 2001 operations summary for Sherburne Reservoir describes below average storage conditions (16.5 meters, or 54 feet below full pool; 9 percent of capacity) at the beginning of the water year (October 1, 2000), due to lingering drought conditions (USBR 2001). In a normal year about 12.3 million cubic meters (10,000 acre-feet) of water, or about 15 percent of full pool capacity, remains in the reservoir on October 1. The reservoir did not fill during 2001 (7.6 meters or 25 feet below full pool) and reservoir inflow was the lowest recorded since 1977. Diversion into the canal began on April 18, 2001, and the reservoir pool decreased until a runoff event May 12. Peak inflow to the reservoir for the year was 31.7 cubic meters per second (1,121 cubic feet per second) on May 14. Diversion to the Saint Mary Canal averaged 16.6 to 18.4 cubic meters per second (586 to 649 cubic feet per second) during May through July, 2001, with only a portion of that flow supplemented by the reservoir and the rest from natural flows in the Saint Mary River. Canal diversions were discontinued on August 14, 2001, and releases from the reservoir were discontinued on August 28, with the exception of one week during September when 2.7 million cubic meters (2,200 acre-feet) of water was released to refund a deficit to Canada (USBR 2001). For the water year 2001, the total diversions from the Saint Mary River to the Milk River Irrigation Project were 162 million cubic meters (131,433 acre-feet), 89 percent of the long-term average of 181 million cubic meters (147,000 acre-feet). For the previous 20 years (1980 to 1999) diversions averaged 220 million cubic meters (178,000 acre-feet) per year, and the largest diversion was 342 million cubic meters (277,000 acre-feet) in 1989.

The channel of Swiftcurrent Creek immediately downstream from Sherburne Dam is relatively stable, due in large part to the controlled flow regime. In most years the stream is completely dewatered in November through February, though prior to dam construction base flow was typically between 0.6 cubic meters per second (20 cubic feet per second) and 2.8 cubic meters per second (100 cubic feet per second) (USGS 2002).

The mean monthly streamflow in Swiftcurrent Creek, downstream of the dam, for the 89-year period of record (USGS 2002), is presented in Table 1.

Table 1. Mean monthly streamflow in Swiftcurrent Creek, downstream of the dam, for the 89-year period of record (USGS 2002).

	March	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**
cubic meters per second	2.1	5.8	10.6	11.6	11.9	13.9	9.6	3.0
cubic feet per second	75	206	374	408	420	490	339	106

From the confluence of Boulder Creek downstream to Lower Saint Mary Lake there is major instability of the Swiftcurrent Creek stream channel. Following the large flood in 1964, the lower portion of Swiftcurrent Creek was rerouted from its natural confluence with the Saint Mary River downstream from Lower Saint Mary Lake, to its current location in the lower end of the lake itself. A constructed levee, originally built by the Civilian Conservation Corps in the 1930's and fortified since by the U.S. Bureau of Reclamation, helps to maintain the diverted configuration (R. Wagner, USFWS, pers. comm., 2002). Boulder Creek, which joins the lower reaches of Swiftcurrent Creek, contributes high volumes of bedload to the system. The unstable migrating channel of lower Swiftcurrent Creek remains problematic from the standpoint of roads and human development in the area, but provides favorable habitat for juvenile bull trout. Sediment removal efforts and a variety of dredging projects and stabilization proposals have been either contemplated or implemented over the years in lower Swiftcurrent Creek.

A heavily traveled scenic highway follows Swiftcurrent Creek and the north shore of Lake Sherburne to the Many Glacier development on Swiftcurrent Lake, just upstream from the reservoir. According to Morton (1961), the Many Glacier area was settled before 1900 by miners who “developed quite an industry, on a small scale, working out of the village of Altyn,” where ruins remain at the mouth of Apikuni Creek. An historical hotel complex and campground now occupies this area, with oneof the most popular trailheads in

Glacier National Park starting there. Many Glacier Hotel was described by Morton (1961) as "the chief social center of Glacier National Park".

Larger lakes in the upper Swiftcurrent Creek drainage, upstream of Swiftcurrent Falls, include Swiftcurrent (about 53 hectares or 130 acres), Lake Josephine (about 73 hectares or 180 acres), Grinnell (about 49 hectares or 120 acres), Iceberg (about 20 hectares or 50 acres), Redrock (about 16 hectares or 40 acres), and Upper Bullhead (about 21 hectares or 52 acres) (Morton 1961). Most of these lakes support introduced populations of rainbow trout, brook trout, and in some cases kokanee (Morton 1961). A series of impassable waterfalls are found between many of these lakes in the upper basin. Morton (1961) also recounted the contents of a letter from H.A. Noble, general manager of the Glacier National Park Hotel Company, to then-superintendent J.R. Eakin, dated November 9, 1921. The letter indicated the first fish planted in the Swiftcurrent area were brook trout and rainbow trout in 1912 and that:

> "The Two Medicine, Gunsight, McDermott (aka Swiftcurrent), Josephine, Grinnell and the Swift Current Lakes contained no fish until they were stocked with them by us. Lower Two Medicine, Red Eagle, Saint Mary, Sherburne, and Cracker Lake all contained fish when Glacier National Park was created.

Cracker Lake

Cracker Lake is drained by Canyon Creek, a tributary which flows north about 7 kilometers (4 miles) over a series of small waterfalls, before entering the upper end of Lake Sherburne. Canyon Creek is the largest tributary of the Swiftcurrent basin upstream from the dam, and was described by Brooks (1921), as cited in Morton (1961), as a "spawning grounds for Lake Sherburne whitefish and native cutthroat trout." Bull trout were not mentioned.

Boulder Creek

Boulder Creek originates in a glaciated valley situated between the Saint Mary lakes and Lake Sherburne. Boulder Creek's headwaters arise from snowmelt near Siyeh Pass and it flows northeast about 20 kilometers (12 miles) before entering Swiftcurrent Creek, about 5 kilometers (3 miles) above Lower Saint Mary Lake. About 6 kilometers (4 miles) upstream from the Glacier National Park boundary, Boulder Creek flows become entirely subsurface as they pass through gravel-cobble alluvium for about 400 meters

(1,300 feet) during low-flow periods in late summer (Mogen and Kaeding 2001). The creek then emerges as groundwater upwellings and flows through a 3 kilometer (2 mile) low-gradient reach characterized by braided channels and abundant damming by beaver (*Castor canadensis*).

Because Boulder Creek has historically exhibited notably large seasonal flow events much of the channel in the creek's lower reaches is wide, braided, and composed of unstable and shifting substrate consisting predominantly of boulders and other large materials. The instability of lower Boulder Creek is a natural condition, not unlike that which occurs in Divide Creek, and the delta formed in the lower reaches seems to provide excellent habitat for juvenile bull trout despite the instability. The large contribution of bedload from Boulder Creek continues downstream through the Swiftcurrent Creek channel and into Lower Saint Mary Lake.

Kennedy Creek

Kennedy Creek, the next drainage north of Swiftcurrent Creek (Figure 2) originates at Kennedy Lake and flows northeast about 28 kilometers (17 miles) before entering the Saint Mary River about 8 kilometers (5 miles) downstream from Lower Saint Mary Lake. An approximately 10 meter (33 feet) high waterfall occurs at the outlet of Poia Lake, about 5 kilometers (3 miles) upstream from Glacier National Park boundary on Kennedy Creek (Mogen and Kaeding 2001). Immediately downstream from Poia Lake, Kennedy Creek enters a high-gradient, boulder-strewn canyon. At the mouth of that canyon, about 0.7 kilometers (0.4 miles) below the lake, the valley widens and the creek's gradient declines. In that reach, Kennedy Creek disappearsinto the gravel-cobble alluvium during low-flow periods in late summer. About 300 meters (1,000 feet) downstream, however, the creek emerges as groundwater upwellings and flows through a 1.5 kilometer (1 mile) low-gradient reach characterized by braided channels and abundant beaver activity (Mogen and Kaeding 2001).

Otatso Creek

Otatso Creek originates at Otatso Lake and flows east about 18 kilometers (11 miles) before joining Kennedy Creek, nearly 5 kilometers (3 miles) upstream from the confluence of Kennedy Creek with the Saint Mary River (Figure 2). A large waterfall (approximately 50 meters, or 164 feet high) occurs in the headwaters of Otatso Creek, 15

kilometers (9 miles) upstream from the confluence with Kennedy Creek. Two kilometers (1 mile) downstream from the waterfall, Slide Lake is formed by a large landslide across Otatso Creek. Otatso Creek flows are entirely subsurface for nearly 100 meters (33 feet) while passing through the landslide, during all but seasonal high-flow periods (Mogen and Kaeding 2001). From that location, Otatso Creek continues downstream through a 2 kilometer, high-gradient, boulder-strewn canyon before flowing over a second waterfall (3 meters, or 10 feet high) about 12 kilometers (7.5 miles) above the confluence with Kennedy Creek and near the Glacier National Park boundary. Downstream from that waterfall, Otatso Creek enters a canyon that has exposed, highly erodible, shale walls that contribute substantially to the sediment load of the stream (Mogen and Kaeding 2001). Consequently, instream habitat in the lower reach of Otatso Creek is not as diverse and most substrates are embedded.

Lee Creek

Lee Creek, and its tributaries Jule, Middle Fork Lee, and East Fork Lee creeks, drain the northern-most portion of the Saint Mary watershed in Montana. Lee Creek originates as snowmelt in the northeast corner of Glacier National Park and flows north about 11 kilometers (7 miles) before crossing the international border. It then meanders about 50 kilometers (31 miles) through mostly shrub-grassland habitat of southern Alberta, before entering the Saint Mary River near the town of Cardston, a few kilometers upstream from Saint Mary Reservoir.

Saint Mary River, Canada

In Alberta, the Saint Mary River flows 163 kilometers (101 miles) from the international border to its confluence with the Oldman River. Between the international border and Saint Mary Reservoir the river flows through prairie foothills, averages 32 meters (105 feet) in width, and is considered a cold water trout stream (Longmore and Stenton 1981). Bull trout and mountain whitefish (*Prosopium williamsoni*) are considered the primary salmonid species, but fish production is considered only moderate and is limited primarily by sediment (Longmore and Stenton 1981).

Deep pools in the Saint Mary River upstream from Saint Mary Reservoir provide habitat for bull trout (Longmore and Stenton 1981). Saint Mary Reservoir supports a variety of game fish species, including rainbow trout, cutthroat trout, northern pike,

walleye (*Stizostedion vitreum*), and lake whitefish (*Coregonus clupeaformis*). Saint Mary Reservoir is subject to extreme water level manipulation. The reservoir has a turnover rate of three times annual storage, resulting in poor zooplankton production (Longmore and Stenton 1981). Normal water level fluctuation is about 7 meters (23 feet), which reduces the reservoir surface area by about half. However, during the last few drought years the reservoir has routinely been drained to dead storage elevation, 25.5 meters (84 feet) below full pool (T. Clayton, Alberta Sustainable Resource Development, pers. comm., 2002).

Below Saint Mary Reservoir, the Saint Mary River takes on a low gradient, meandering, gravel bottom course as it progresses across flat, arid prairie lands (Longmore and Stenton 1981). The average width of the river is 57 meters (187 feet) near Lethbridge and it is heavily dewatered for irrigation. Summer water temperatures in the lower Saint Mary River averaging as cold as 12 degrees Celsius (54 degrees Fahrenheit) were recorded in the 1970's in the hypolimnetic discharge waters immediately downstream from Saint Mary Dam. However, the river warms rapidly as it progresses downstream, especially in low flow years, and much higher summer water temperatures in the lower river are common. For example, closer to the Oldman River confluence near Lethbridge average summer water temperature was 19.1 degrees Celsius (66.4 degrees Fahrenheit) in 2000, and 19.9 degrees Celsius (67.8 degrees Fahrenheit) in 2001 (T. Clayton, pers. comm., 2002).

Pike and other warm water fish species inhabit the lower Saint Mary River, although mountain whitefish are still common (Longmore and Stenton 1981). Fish production is considered low due to degraded habitat conditions and heavy dewatering that occurs during the summer irrigation season. In addition, treated municipal sewage from the town of Cardston, and untreated cattle waste from local feedlots further degrade water quality (Longmore and Stenton 1981).

In summary, the Saint Mary River downstream from Saint Mary Reservoir does not provide favorable habitat for bull trout, and the dam is a permanent barrier to upstream migration for any bull trout found in the lower river.

Belly River

The Belly River originates on the east slope of the Rocky Mountains, in the northernmost portion of Glacier National Park, between the Saint Mary River drainage to the east and the Waterton River drainage to the west. The Belly River flows north for about 20 kilometers (12 miles), entirely within glaciated valleys and lakes in Glacier National Park, before crossing the international border into Alberta, Canada (Figure 3). In Canada, the Belly River flows through mostly prairie foothill habitat from the international border to the confluence of the Oldman River, some 181 kilometers (112 miles) downstream. Just north of the border the river flows through the eastern edge of Waterton Lakes National Park and a portion of the Blood Reserve, before continuing on across private, Tribal, and provincial lands for about 50 kilometers (31 miles) to the junction of the Waterton River.

The headwaters of the Belly River is at Helen Lake (about 77 hectares or 190 acres). Elizabeth Lake (about 97 hectares or 240 acres) is located on the mainstem of the Belly River about 4 kilometers (2.5 miles) downstream from Helen Lake. Dawn Mist Falls, downstream from Elizabeth Lake is a large falls that forms a natural fish barrier.

The Mokowanis River, also known as the Middle Fork of the Belly River, is about 19 kilometers (12 miles) long and consists largely of a group of connected headwater lakes, including (in downstream order) Ipasha (about 24 hectares or 60 acres), Margaret (about 32 hectares or 80 acres), Mokowanis (about 19 hectares or 48 acres), Sue (about 34 hectares or 85 acres), Glenns (130 hectares or 320 acres), and Cosley (about 97 hectares or 240 acres). These lakes contain a variety of introduced species, including rainbow trout and brook trout, as well as native westslope cutthroat trout, lake trout, and mountain whitefish. The Mokowanis joins with the main Belly River just upstream from the Belly River Ranger Station, about 10 kilometers (6 miles) south of the international border. Gros Ventre Falls (Figure 3), located on the Mokowanis River just downstream from Cosley Lake and less than 2 kilometers (1 mile) from the Belly River junction, is an impassible natural upstream barrier to fish (Morton 1961). Bull trout are considered to be absent from the Mokowanis River upstream from Gros Ventre Falls.

Over its course across Alberta, Canada, the physiography and ecology of the Belly River changes dramatically (Longmore and Stenton 1981). A distinct transition from cold water to warm water habitat occurs. In the foothills between the international border and

the United Irrigation District weir 35 kilometers (22 miles) downstream (Figure 3) the river flows through open rangeland interspersed with forest. The steep gradient and coarse, rocky substrate contribute to swift, turbulent aquatic habitat. At the Mountain View Irrigation District weir the channel of the Belly River averages 23 meters (76 feet) in width. In 1980, summer water temperatures averaged 10.6 degrees Celsius (51 degrees Fahrenheit), and reached a maximum of 18 degrees Celsius (64.4 degrees Fahrenheit) (Longmore and Stenton 1981).

Downstream from the United Irrigation District diversion intensive agriculture surrounds the river. Agricultural water and land use negatively impact the river environment due to irrigation withdrawal and water quality degradation from feedlot discharge (Longmore and Stenton 1981). The river channel broadens and meanders and the water is warmer, averaging 13 degrees Celsius (55.4 degrees Fahrenheit) and reaching a maximum of 21 degrees Celsius (69.8 degrees Fahrenheit) in the summer of 1980 (Longmore and Stenton 1981).

Downstream of the confluence with the Waterton River, the Belly River supports a mixed warm and cool water fish population, with maximum summer water temperatures as high as 24 degrees Celsius (75 degrees Fahrenheit). The lower Belly River is considered to be of low productivity, due primarily to extreme dewatering (Longmore and Stenton 1981) Common fish species include mountain whitefish, northern pike, and sauger (*Stizostedion canadense*), while bull trout are rare.

DISTRIBUTION AND ABUNDANCE

Historical Status

The Saint Mary, Belly, and Waterton river drainages comprise much of the southern portion of the headwaters of the Oldman River in southwestern Alberta, Canada. The Oldman River is in the South Saskatchewan River drainage, eventually reaching Hudson Bay. Bull trout populations in the Oldman River drainage in Alberta are reduced from historical levels of the early part of the 20th century (Brewin and Brewin 1997). Fitch (1997) evaluated the current (post-1970) versus historical (1900 to 1970) distribution of bull trout in drainages of southwest Alberta, based on anecdotal as well as known distributional information. Bull trout were verified to have historically inhabited the headwaters portions of the Saint Mary and Belly River drainages in Alberta (Fitch 1997). Bull trout were assumed to have occupied the lower mainstem portions of these rivers, to the confluence with the Oldman, but their occurrence could not be documented (Fitch 1997). It was estimated that if the natural distribution was drainage wide, then bull trout distribution in Alberta has been reduced by 70 percent in the Belly River and 80 percent in the Saint Mary River drainage from historical conditions (Fitch 1997).

However, current evidence suggests that while bull trout may have been occasionally present, they were not commonly distributed in those downstream river reaches. Consequently, the actual percent reduction in historical distribution in Canada may have been less than Fitch (1997) proposed. While bull trout did undoubtedly extend farther downstream than currently exists (Brewin and Brewin 1997), it is likely that the mountains and transitional zones were always the true bull trout strongholds in the Saint Mary and Belly Rivers. Functional connectivity with bull trout in other portions of the Oldman River headwaters may not have occurred, even under natural conditions prior to human influence in recent times.

In the United States, similar estimates of historical versus current distribution are not available, but inferences can be made from analysis of historical distribution information. There is no historical record that bull trout were ever found in the Waterton River drainage in Glacier National Park. Bull trout are believed to occur in a largely intact, though naturally limited distribution (by waterfalls or other natural barriers) in the Belly

River watershed in Glacier National Park, where habitat has not been noticeably altered. It was once suspected that substantial decreases in bull trout abundance, and perhaps range reductions had occurred in the Saint Mary River drainage in the United States (Fredenberg 1996). However, more recent survey data (Mogen and Kaeding 2002) indicate that bull trout continue to inhabit most of the suitable habitat accessible to them in the Saint Mary River drainage in the United States. There is little information concerning current versus historical abundance.

During the summers of 1909 through 1911, Professor Morton J. Elrod of the University of Montana studied Glacier National Park lakes to determine which "barren" waters would be suitable fish habitat. Elrod's limnological evaluation represented the first aquatic research conducted in Glacier National Park (Morton 1964). *Elrod's Guide to Glacier Park*, first published in 1924, contained a "Table of East Side Waters and Species of Fish Therein" which indicated bull trout (referred to as Dolly Varden) were present in North Fork Kennedy Creek (now known as Otatso Creek) and Slide Lake, South Fork Kennedy Creek below an unnamed (Poia) Lake, Lake Sherburne, Cracker Lake, Saint Mary Lake and Lower Saint Mary Lake, Boulder Creek, Red Eagle Lake, and Red Eagle Creek (Elrod 1930). With the probable exception of Lake Sherburne, bull trout remain present today in all the waters listed by Elrod.

Saint Mary Lake historically contained native bull trout, lake trout and westslope cutthroat trout, as well as native populations of lake whitefish and mountain whitefish. Rainbow trout and brook trout were introduced in the early 1900's. Numbers of bull trout in the lake appear to have been low through recorded history, as they probably are today. There is nearly no information available regarding distribution, abundance, and habitat preference of bull trout that may occupy Saint Mary Lake or Lower Saint Mary Lake, either current or historically, and the spawning and rearing stream(s) used by any migratory bull trout in Saint Mary Lake are also largely unknown.

Existence of strong populations of lake trout and bull trout seldom occur together anywhere in the overlapping range of these species (Donald and Alger 1993). These species from the same genus appear to be largely incompatible (Donald and Stelfox 1997) and where habitat conditions are suitable for lake trout, that species typically dominates (Fredenberg *in press*). Thus, in the large lakes of the Saint Mary River drainage where

lake trout are native, it is likely that bull trout were primarily fluvial. Adfluvial bull trout and westslope cutthroat trout may have never been abundant. However, the lakes may have been important transitional habitat for bull trout during certain times of year, or for certain life stages. Recent radio telemetry studies provide indications that some adult bull trout overwinter in Lower Saint Mary Lake (Mogen and Kaeding 2001).

Because bull trout exhibit patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), the fish are not expected to simultaneously occupy all available habitats (Rieman *et al.* 1997). Under natural conditions, some gaps in bull trout distribution within the Saint Mary and Belly rivers probably occurred. Due to the extreme geology of this glaciated region there are numerous natural barriers that have isolated some populations (Figure 3). In addition, some human-caused barriers exist. Dams, diversions, and other artificial structures have the potential to alter bull trout distribution, by introducing physical and thermal barriers within formerly continuous systems.

Red Eagle Lake is a small alpine lake draining into Saint Mary Lake. Red Eagle Lake was noted by Elrod (1930) to contain bull trout. Lake trout are not believed present in Red Eagle Lake and the bull trout population is considered native.

Between Saint Mary Lake and Lower Saint Mary Lake bull trout inhabit a 2 kilometer (1.2 mile) reach of the Saint Mary River (Fredenberg 1996). The Saint Mary River at that location provides an important migratory corridor. Lower Saint Mary Lake and the rest of the Saint Mary River drainage in the U.S. is largely on the Blackfeet Reservation.

Historically, Lee Creek may have also been a spawning stream for fluvial bull trout migrating out of the adjoining reaches of the Saint Mary River in Alberta, Canada. The headwaters of Lee Creek are in the United States and the mainstem flows north through Alberta to the town of Cardston, before joining the Saint Mary River a few kilometers downstream. Angling for bull trout from the bridges in Cardston in late spring or early summer was a popular activity in the 1930's (Fitch 1997). It is reported that the construction of Saint Mary Reservoir on the Saint Mary River a few kilometers downstream from the mouth of Lee Creek, in 1946, was probably a major factor in diminishing the Lee Creek bull trout run (Fitch 1997). Irrigation diversions in lower Lee

Creek and degraded habitat downstream from the town site of Beazer may have also played a role in the decline.

The Belly River drainage lies west of the Saint Mary drainage in Glacier National Park, and is flanked on its west side by the Waterton River drainage. While the Waterton and Belly river drainages both contain populations of bull trout in Canada, there are no documented bull trout populations in the portions of the Waterton River in the United States (Morton 1961). Morton (1961) does report a 50 centimeter (20 inch) bull trout taken by an angler in the Waterton River upstream from Waterton Lake, noted in a park ranger creel survey on July 23, 1960. However, Morton (1961) believed it to be a case of mistaken identity of a "Mackinaw or lake charr that had moved in from the lake". Because there is no current or historical evidence of bull trout populations in the United States portions of the Waterton River drainage, the Draft Bull Trout Recovery Plan (USFWS 2002) does not address this drainage.

Bull trout were occasionally reported to occur in Glenn's Lake in the Belly River drainage historically, and as recently as 1960 (Morton 1961). While it is possible these reports were due to misidentification, they cannot be summarily dismissed. No recent information is available. Native westslope cutthroat trout were also historically reported in these lakes. In addition, lake whitefish are native to the drainage and could have persisted along with lake trout, but they are not known to occur in other areas in the Belly River headwaters in Alberta. The historical and current distribution and abundance of fish species in the Belly River headwaters in Glacier National Park represents a research need.

Status of Bull Trout at the Time of Listing

In the final listing rule for bull trout the Saint Mary - Belly River is treated as one of five distinct population segments (USFWS 1999). The Saint Mary - Belly Distinct Population Segment is considered discrete because it is segregated from other bull trout (in the United States) by the Continental Divide and is significant because its loss would result in a significant reduction in the range of the taxon within the coterminous United States (USFWS 1999). In the listing rule three subpopulations of bull trout were recognized within the Saint Mary River, and one in the Belly River basin. At the time of listing, status of two of the three Saint Mary River bull trout subpopulations, and the Belly River

subpopulation, were each considered "depressed", meaning they contained fewer than 500 spawning adults or 5,000 total fish. Status of the fourth subpopulation was considered unknown. All were considered to have unknown population trend and all were considered to be at risk of stochastic extirpation, due to restricted habitat and small population size.

In the final listing rule the greatest identified threats to bull trout in the Saint Mary - Belly River Recovery Unit were considered to be dams and unscreened diversions, and the impacts of nonnative fishes. The former were noted to inhibit fish movement and possibly entrain fish into diversion channels as well as to alter habitat by associated dewatering. The magnitude of threats was rated high for the Saint Mary River and Belly River subpopulations and the threats were considered imminent.

The best scientific evidence now available indicates that the subpopulation groups we described in the listing rule are each composed of one to many local populations. Due to the adoption of revised terminology by the recovery team, the Draft Bull Trout Recovery Plan (USFWS 2002) addresses recovery actions and analysis by core areas and their local populations, rather than referring to subpopulation groups.

Current Distribution and Abundance

Saint Mary River Core Areas

Bull trout are present in most of the principal tributaries of the Saint Mary River in Montana, including Divide, Boulder, Kennedy, Otatso, and Lee creeks (Mogen and Kaeding 2001). An isolated population of bull trout is found in Slide Lake, in the upper Otatso Creek drainage. Bull trout also occur in what is believed to be an introduced population in Cracker Lake (Fredenberg 1996), at the headwaters of Canyon Creek upstream from Lake Sherburne. No other bull trout populations exist in the Swiftcurrent Creek drainage upstream from Sherburne Dam. Thus, it can be concluded bull trout are widely distributed in the Saint Mary River drainage and occur in nearly all of the waters that they inhabited historically (Mogen and Kaeding 2001).

We have described five core areas in the Saint Mary River system. **Saint Mary River is described as the primary core area in this drainage, and upper Lee Creek, Red Eagle Lake, Cracker Lake, and Slide Lake are described as secondary core areas**

(see discussion of secondary core areas on page 2). As described, a core area is considered to be the closest approximation of a biologically functioning unit for bull trout, containing all the necessary elements for long-term survival (see Chapter 1). Most of the interconnected Saint Mary River watershed in the United States, extending downstream to the international border, is considered one core area (Figure 2). In addition, four small and isolated fragments of the range in the United States have been designated as separate secondary core areas in the watersheds of Slide Lake, Red Eagle Lake, upper Lee Creek, and Cracker Lake (Figure 2).

In recent years, emphasis in the Saint Mary River and Belly River basins has been placed on documenting distribution and determining abundance through the use of redd surveys, fish traps and radio telemetry, and electrofishing survey. Due to the large size of migratory fish and the geology of the streams (which generally makes the redds recognizable), redd counts (Spalding 1997) have been shown to provide a repeatable method of indexing spawner escapement in many streams in the range of bull trout (Rieman and McIntyre 1996). However, several authors have cautioned that redd counts should not be relied upon as the sole method of population monitoring (Maxell 1999, Rieman and Myers 1997) and may, in fact, lead to erroneous conclusions about population status and trend.

Saint Mary River Redd Surveys

Mogen and Kaeding (2001) reported that Divide Creek contained habitat seemingly suitable for bull trout spawning. Included was an upwelling reach downstream from a seasonally dewatered zone that appeared functionally similar to areas used for bull trout spawning in Kennedy and Boulder creeks. However, no redds were identified in Divide Creek in 1997 (the only year redd surveys were conducted); only two bull trout (one male and one female) were captured in the Divide Creek trap that year. No bull trout were captured in the trap on Divide Creek in 1998, or during electrofishing surveys in 1998 and 1999 (Mogen and Kaeding 2001). Juvenile bull trout were captured by electrofishing in the upper reaches of Divide Creek during 2002 (J. Mogen, USFWS, pers. comm., 2002a). This local population appears to have been reduced to sporadic spawning, in only occasional years, and could be nearing demographic extinction due to the low and erratic numbers.

In 1997, preliminary redd surveys in the Saint Mary River watershed identified bull trout spawning areas in Kennedy and Boulder creeks, both within Glacier National Park (Mogen and Kaeding 2001). Spawning in both streams occurred in areas of apparent groundwater upwelling, just downstream from the major regions of entirely subsurface flow during low-flow periods (*i.e*. migration barriers). Habitat characteristics of these spawning areas included widened valleys, braided, low- gradient channels with gravel substrates, and beaver activity. Although seemingly suitable spawning habitat occurred further downstream from the spawning areas in Boulder and Kennedy creeks, no redds were identified in those areas.

Only 12 redds were identified at the Boulder spawning area in 1997, compared to 42 in 1998, 20 in 1999, 30 in 2000, and 28 in 2001 (Mogen and Kaeding 2002). In general, more redds were counted in surveys conducted in October than in November, perhaps because redds are more evident early in the post-spawning season. At the Kennedy Creek spawning area, 23, 37, 23, and 12 bull trout redds were identified in 1997, 1998, 2000, and 2001 respectively; no survey was conducted in 1999 (Mogen and Kaeding 2002). Redds in Kennedy and Boulder creeks were believed to have been made by migratory fish (Mogen and Kaeding 2001).

Mogen and Kaeding (2001) suspected bull trout may have also spawned in lower Otatso Creek in the reach accessible to migratory bull trout from the Saint Mary River (based in part on the capture of large, spent adults in the trap). However, redds have not been identified in lower Otatso Creek downstream from the barrier falls at Glacier National Park despite searches conducted in 1997 through 2000. Suitable habitat was found to be limited, in part due to embedded substrate and high levels of fine sediment.

More research is needed in the area of lower Otatso Creek to clearly define the origin and status of these fish. At this time the lower Otatso and Kennedy creek fish are considered to belong to one local population for recovery purposes. However, evidence presented by Spruell *et al.* (2002) suggests that based on genetic attributes bull trout collected in lower Otatso Creek appear more likely to have originated from upper Otatso Creek or Slide Lake, rather than being from either the Kennedy Creek or Boulder Creek populations. Adult bull trout found in lower Otatso Creek may be stranded adults that are unable to return to upriver spawning locations.

Two bull trout redds were found in 1997 in the reach of Otatso Creek immediately downstream from Slide Lake (Figure 2). Fish in this reach may be downstream emigrants from Slide Lake that end up trapped between the two barriers. Excellent spawning and rearing habitat exists in the portion of Otatso Creek just upstream from Slide Lake, and spawning adfluvial fish from Slide Lake are known to use upper Otatso Creek.

Although redd surveys were not conducted by Mogen and Kaeding (2001) in Lee Creek, spawning by migratory bull trout historically occurred there. Large bull trout observed there (Mogen and Kaeding 2001) were suspected to winter in Canada in lower Lee Creek, the Saint Mary River, or perhaps Saint Mary Reservoir.

Within the Saint Mary River drainage two streams in the United States (Boulder and Kennedy creeks) are now being monitored, with index redd counts conducted on an annual basis. Ongoing redd counts in the drainage are not currently being conducted in Canada. Redd counts have traditionally been conducted only for migratory fish. In some drainages (*e.g.*, middle Otatso Creek and Lee Creek) there may be additional resident bull trout spawners whose redds are much smaller. They are difficult to verify and have not been inventoried regularly.

Saint Mary River Trapping and Radio Telemetry

Mogen and Kaeding (2001) collected the first quantitative information on the migratory movements and timing of adult bull trout spawning migrations in the Saint Mary River basin in the United States. Bull trout were trapped annually in Boulder, Kennedy, and lower Otatso creeks between 1997 and 2000, in Divide Creek in 1997 and 1998, and in Lee Creek in 1999 and 2000, to collect information on post-spawning downstream migrating adults (Mogen and Kaeding 2001). Box traps with picket weir wings were typically operated between late August and mid-October and bull trout over 20 centimeters (8 inches) that were captured were implanted with passive integrated transponder (PIT) tags.

Total annual captures of adult bull trout in the Boulder, Kennedy, and Otatso creek traps varied markedly among years (Table 2). Most fish were downstream migrants captured post-spawn.

Generally, resident bull trout would not be expected to exhibit regular movement patterns, and thus all fish captured in downstream traps are considered to be migratory. The greatest numbers of juvenile (less than 30 centimeters or 12 inches total length) migratory bull trout were captured in the Boulder Creek trap in 1997 and 1998 and in the Lee Creek trap in 1999 and 2000. Although migratory adult bull trout were captured shortly after the traps were installed in all years, most were captured after mid-September (Mogen and Kaeding 2001).

Table 2. Number of adult-sized bull trout (longer than 30 centimeters or 12 inches total length) trapped in five tributary streams of the Saint Mary River drainage during late August through late October, 1997 through 2000 (from Mogen and Kaeding 2001).

Stream	1997	1998	1999	2000
Divide Creek	2	0	NA	NA
Boulder Creek	17	64	23	23
Kennedy Creek	32	38	20	9
Otatso Creek (lower)	16	19	11	12
Lee Creek (upper)	NA	NA	19	4

Total lengths of all bull trout (sample size of 626) captured in the fish traps ranged from 13 to 76 centimeters (5.1 to 29.9 inches) during the 4 years of trapping (Mogen and Kaeding 2001). Adult sizes were consistent between years, averaging 47 to 50 centimeters (18.5 to 19.7 inches) total length each year.

Altogether, 555 bull trout longer than 200 millimeters (8 inches) total length received either visual implant (VI) or passive integrated transponder (PIT) tags during the study (Mogen and Kaeding 2002). Of that total, 206 fish (37 percent) were captured and tagged at the traps (1997 to 2000) and 349 fish (63 percent) during electrofishing surveys (1998 to 2001). A total of 142 tagged bull trout that were released were caught in traps or by electrofishing in subsequent years (Mogen and Kaeding 2002). Distances traveled between tagging locations and probable wintering areas ranged from approximately 1 to 75 kilometers (1 to 47 miles).

Most (84 percent) bull trout recapture events in subsequent years occurred in the stream from which the fish was originally captured. However, 23 instances occurred of a bull trout tagged in one stream being recaptured in another stream (Mogen and Kaeding 2002). Movements of tagged bull trout occurred back and forth among Boulder, Kennedy, and lower Otatso creeks; but not between Lee Creek or upper Otatso Creek and the other streams. The most frequent crossovers were for fish tagged in lower Otatso Creek that were subsequently captured nearby in Kennedy Creek (nine times), or the reverse of that pattern (six times). However, five fish tagged in Kennedy Creek were later recaptured in Boulder Creek, requiring considerable upstream movement and passage over the Saint Mary Diversion. That evidence of movement is partially why the interconnected Saint Mary system was considered a single core area, but Lee Creek and Slide Lake form separate secondary core areas (see discussion of secondary core areas on page 2).

Finer scale genetic analysis (Spruell *et al.* 2002) found significant genetic differences among Kennedy, Boulder, and Otatso creek populations, suggesting there was limited gene flow among sites within these watersheds and that managers should consider these genetic differences important for maintaining long-term persistence of these populations. Samples from Otatso Creek were more differentiated than those from Kennedy and Boulder creeks, which clustered more closely to one another. Spruell *et al.* (2002) cautions that evidence of adult bull trout moving among the lower reaches of different tributaries does not in itself equate to gene flow. The authors conclude that bull trout recovery in the Saint Mary River drainage may provide a significant challenge to managers due to the complexities of preserving populations that suggest there is restricted gene flow among sites, even though the studies of Mogen and Kaeding (2002) show the fish to be highly mobile in the watershed.

Stream temperatures that decline to the range of 5 to 9 degrees Celsius (41 to 48 degrees Fahrenheit) have been considered important to initiation of bull trout spawning (McPhail and Murray 1979, Fraley and Shepard 1989). Mogen and Kaeding's (2001) data on tributary temperatures and the cumulative catches of ostensibly post-spawning, adult bull trout caught moving downstream in traps are consistent with that association. Their data also suggest that most adult bull trout that spawned in the tributaries of the Saint Mary River probably did so after having been in the tributaries at least a few weeks. Although seasonal temperature trends were similar among the five study streams,

Kennedy Creek generally exhibited the warmest temperatures, followed by Otatso, Boulder, Divide, and Lee creeks, respectively (Mogen and Kaeding 2001). Mean daily temperatures of Swiftcurrent Creek and the Saint Mary River were appreciably higher than concurrent temperatures of the spawning streams during most of the trapping periods. While Swiftcurrent Creek temperature regimes may have been naturally warmer than some surrounding drainages during summer, there are also potential effects of temperature modification in the storage pool behind Sherburne Dam that likely vary on a seasonal basis. These effects might be enhanced due to the unnaturally high discharge volume in the Swiftcurrent Creek channel during the irrigation season. The potential impacts of the altered temperature regime on bull trout movement patterns are currently not well understood. However, because bull trout are well known to be sensitive to thermal conditions, that aspect of system operations should receive further evaluation.

Gust (2001) found that growth rates of bull trout did not differ among tributaries of the Saint Mary River, and that bull trout growth in the Saint Mary River drainage was similar to that of bull trout in portions of the Columbia River drainage, Montana.

Mogen and Kaeding (2001) also conducted movement evaluations of 29 adult bull trout that were radio tagged at the trap sites in 1998 to 2000. Eight bull trout (one Boulder Creek fish and seven Kennedy Creek fish) were found scattered through the lower Saint Mary River in Canada during winter. Nineteen radio tagged fish apparently wintered in Montana; including 12 in the Saint Mary River (four of which were originally tagged in Boulder Creek, five in Kennedy Creek, and three in Otatso Creek), three in Lower Saint Mary Lake (all originally tagged in Boulder Creek), and three in Swiftcurrent Creek downstream from Sherburne Dam (all originally tagged in Boulder Creek). Bull trout winter habitats that were examined were generally deep pools. Nothing more is known about habitat use of Saint Mary Lake and Lower Saint Mary Lake by bull trout. The records of radio tagged bull trout detected by three stationary receivers maintained along the course of the Saint Mary River suggest two annual periods of appreciable fish movement in the Saint Mary River, the first about June and the other about October (Mogen and Kaeding 2001). Those periods probably corresponded with the movements of adult fluvial bull trout toward spawning areas in late spring, and the subsequent return movements toward winter habitats in the fall.

Four radio tagged bull trout, all tagged in Boulder Creek, passed downstream over the Saint Mary diversion dam enroute to winter habitats downstream in the Saint Mary River (Mogen and Kaeding 2001). In addition to the Boulder Creek fish, the stationary receiver at the diversion dam recorded two Otatso Creek fish that moved upstream to the diversion dam. One radioed bull trout from Boulder Creek wintered downstream from the dam, appeared at the dam in June and July, and then was captured at the Boulder Creek trap in October; indicating it had passed upstream over the diversion dam.

Saint Mary River Electrofishing and Inventory Survey

Electrofishing surveys of tributaries in the Saint Mary watershed, conducted by Mogen and Kaeding (2002), revealed substantial new information about the known distribution and relative abundance of bull trout, both juveniles and adults.

Divide Creek Drainage

The upper Divide Creek drainage was surveyed at several locations within Glacier National Park, from its head downstream to Glacier National Park boundary (Mogen and Kaeding 2001). No bull trout and only two cutthroat trout (80 and 220 millimeters (3.1 and 8.6 inches) total length) were captured. Lower Divide Creek was surveyed at several locations along a reach from its mouth upstream to Glacier National Park boundary (Mogen and Kaeding 2001). The few fish encountered were hybrid trout (between cutthroat trout and rainbow trout), and mountain whitefish. Although no clear barriers to the upstream movement of fish were encountered in Divide Creek itself, high-gradient cascades probably prohibit fish passage into the few small tributaries to Divide Creek. In August 2002, electrofishing resurvey of upper Divide Creek resulted in the capture of over 20 juvenile bull trout that appeared to be of a single age class (J. Mogen, pers. comm., 2002a). This was considered a positive indication that spawning is occurring in the drainage in at least some years.

Swiftcurrent Creek Drainage

Downstream from Sherburne Dam, Swiftcurrent Creek is heavily dewatered outside the irrigation season. Lake Sherburne, and the chain of lakes upstream (Swiftcurrent, Josephine, Grinnell), which were historically fishless due to Swiftcurrent Falls, now contain populations of introduced species, including rainbow trout, brook trout, and kokanee, as well as native northern pike, mountain whitefish, longnose dace

(*Rhinichthys cataractae*), longnose sucker (*Catostomus catostomus*), and burbot (*Lota lota*) (Wagner and FitzGerald 1995).

Cracker Lake, a small alpine lake in the Canyon Creek drainage which flows into Lake Sherburne, contains an abundant population of small bull trout, with no other species of fish currently known to be present. The fish were believed to be introduced by miners, who were working in the vicinity around the turn of the century. Bull trout have been present in Cracker Lake since at least 1921 (Morton 1961) and under current thinking this population is being treated as a unique, self-sustaining, introduced population of bull trout. However, Mogen and Kaeding (2002) conducted a cursory reconnaissance of Canyon Creek and found no obvious barriers to upstream fish passage. They maintain that bull trout may be indigenous to Cracker Lake (Mogen and Kaeding 2002). The potential for upstream fish passage in Canyon Creek to occur into Cracker Lake needs to be further investigated. Further analysis of the genetic attributes of the fish in Cracker Lake could be instructive as well.

Boulder Creek Drainage

Electrofishing surveys conducted along Boulder Creek, from a location about 2 kilometers (1 mile) downstream of the Glacier National Park boundary to a point about 8 kilometers (5 miles) upstream of the boundary revealed a wide size range of juvenile and adult bull trout, hybrids between cutthroat and rainbow trout, brook trout, and mountain whitefish (Mogen and Kaeding 2001). Many adult bull trout (longerthan 40 centimeters or 15.7 inches total length) were captured just downstream from the reach with entirely subsurface flow (*i.e*. about 6 kilometers or 4 miles upstream from Glacier National Park boundary). The region of subsurface flow is apparently only a seasonal barrier to fish movement. Two tributaries to upper Boulder Creek (entering from the east) were also electrofished in August, 2000. Small bull trout (less than 20 centimeters or 8 inches total length) and cutthroat trout were found in the lower reaches of those streams. The remainder of the tributaries appeared too small or too high-gradient to support fish, and were not electrofished (Mogen and Kaeding 2001).

Kennedy Creek Drainage

The Kennedy Creek drainage, with headwaters in Glacier National Park in Kennedy and Otatso creeks, enters the Saint Mary River several kilometers downstream

from Lower Saint Mary Lake. Bull trout were reported to be present in Slide (aka Otatso) Creek, Slide Lake, and Kennedy Creek as early as the 1920's (Morton 1961).

Mogen and Kaeding (2001) surveyed the entire length of Kennedy Creek, *i.e.* from its mouth to the waterfall at the outlet of Poia Lake. Juvenile and adult bull trout, hybrid trout (rainbow trout by cutthroat trout), brook trout, and mountain whitefish were captured throughout the reach downstream from Poia Lake. No fish were encountered upstream from the waterfall at the Poia Lake outlet or in a 1 kilometer (0.6 mile) reach upstream from the lake. Many adult bull trout (greater than 40 centimeters total length) were captured from a 4 kilometer (2.5 mile) reach of Kennedy Creek located near Glacier National Park boundary, about 5 kilometers (3 miles) downstream from the known bull trout spawning area. About 3 kilometers (2 miles) upstream from Glacier National Park boundary, a tributary enters Kennedy Creek from the north and appeared large enough to support fish. However, a large waterfall (approximately 20 meters or 66 feet high) near the tributary mouth prohibits fish passage upstream. All other tributaries to Kennedy Creek appear too small or too high-gradient to support fish, and were not electrofished (Mogen and Kaeding 2001).

Otatso Creek Drainage

Otatso Creek was also electrofished during 1998 to 2001 (Mogen and Kaeding 2001) at several locations on the Blackfeet Reservation downstream from the waterfall near the Glacier National Park boundary. In that lower reach bull trout from 18 to 46 centimeters (7 to 18 inches) total length, hybrids between cutthroat and rainbow trout, and mountain whitefish were captured. Two tributaries entered lower Otatso Creek from the south, one near Glacier National Park boundary and the other near the confluence with Kennedy Creek. Although both streams appeared large enough to support fish, no fish were encountered during electrofishing surveys (Mogen and Kaeding 2001).

About 3 kilometers (2 miles) upstream from the waterfall near Glacier National Park boundary, a large landslide across Otatso Creek is a barrier to fish movement during the period of seasonal low flows (Mogen and Kaeding 2001). In the 3 kilometer (2 mile) reach of Otatso Creek between the waterfall and the landslide, a presumably resident population of bull trout was found along with a few hybrid trout (cutthroat by rainbow trout) and mountain whitefish. All age groups of bull trout were abundant in the middle

reach of Otatso Creek (upstream from the waterfall near Glacier National Park boundary, but downstream from Slide Lake) (Mogen and Kaeding 2001).

Slide Lake, consisting of two small connected basins formed upstream from the landslide, supports adfluvial populations of bull trout and hybrids between cutthroat and rainbow trout. Slide Lake was not surveyed by Mogen and Kaeding (2001), but contains an adfluvial bull trout population (Stevens, *in litt.* 1996). Some of the fish present in Otatso Creek downstream from Slide Lake may be emigrants from the lake. A 1 kilometer (0.6 mile) reach of Otatso Creek upstream from Slide Lake was surveyed in 1998 to 2000 and was found to contain an abundant population of bull trout of multiple age classes (Mogen and Kaeding 2001). A spawning area was identified in upper Otatso Creek upstream from Slide Lake. Otatso Creek is fishless above a large waterfall (approximately 50 meters or 160 feet high), about 1 kilometer (0.6 miles) upstream from Slide Lake. Several kilometers of stream as well as Otatso Lake, in a headwaters cirque, are fishless.

Lee Creek Drainage

Lee Creek, a major drainage which heads in Glacier National Park and flows northeast about 40 kilometers (25 miles) into Canada, was surveyed in the United States in 1983 and found to contain a substantial bull trout population (Peterson and Hall 1983). A major landslide occurred at Chief Mountain at the headwaters of Lee Creek in 1992. The drainage is prone to flash flood type events. The 1992 landslide carried a large amount of fine sediment downstream. There was some concern the landslide may jeopardize the bull rout population in Lee Creek. However, more recent surveys indicated that the slide primarily impacted Jule Creek (a small tributary to Lee Creek) and major impacts on Lee Creek have not been documented.

Mogen and Kaeding (2001) electrofished Lee Creek at several locations upstream from the Chief Mountain Highway. Juvenile and adult bull, hybrids between cutthroat and rainbow trout, and mountain whitefish were captured. There appears to be some use of Lee Creek by migrant spawners. Several fish implanted with radio transmitters in Montana wintered in the lower portions of the Saint Mary River in Alberta in the vicinity of the Lee Creek confluence (Mogen and Kaeding 2001). Fluvial bull trout from the Saint Mary River may be maintaining a migratory connection with Lee Creek that has not been documented and represents a research need.

Jule, Middle Fork Lee, and East Fork Lee creeks (the small tributaries to Lee Creek), were surveyed both upstream and downstream from their crossings with the Chief Mountain International Highway (Mogen and Kaeding 2001). All of these are small streams. Flows recorded at the mainstem Lee Creek fish trap (near the international border) were only 0.09 cubic meters (3.2 cubic feet) per second on October 15, 2000. Four kilometers (2.5 miles) of Jule Creek, entirely within Glacier National Park, held juvenile bull trout to 15 centimeters (6 inches) in length and hybrids between cutthroat and rainbow trout.

Middle Fork Lee Creek, on the Blackfeet Reservation, is highly impacted by human activities (Mogen and Kaeding 2001). Streamside grazing and logging on Tribal lands have resulted in heavy silt loads and turbidity in the creek, and a perched highway culvert is a barrier (2 meter or 6 foot waterfall) to the upstream movement of fish. Upstream from the culvert, no fish were captured from a 200 meter (650 foot) reach, whereas two juvenile bull trout and several hybrids between cutthroat and rainbow trout were captured from a 500 meter (0.3 mile) reach downstream from the culvert. East Fork Lee Creek supports a population of small cutthroat trout and appears to be similarly impacted by grazing and logging (Mogen and Kaeding 2001).

Drainagewide Summary

Tag-recapture data in the Saint Mary River core area (Mogen and Kaeding 2001) indicates that a substantial proportion of bull trout apparently moves among spawning tributaries. The frequency with which migratory interaction is occurring suggests that reproductive isolation among these spawning stocks may be incomplete (Mogen and Kaeding 2001). Consequently, the entire complex is considered a single core area composed of several local populations.

The data also indicate that bull trout in Slide Lake and upper Lee Creek are isolated from the Saint Mary River Core Area. We presume the same is true for Cracker Lake and Red Eagle Lake, though we have no direct evidence in these two cases. This information has contributed to designating these four areas as secondary core areas.

It is anticipated that additional monitoring and evaluation of the Saint Mary River system and associated diversions and canals will continue (Mogen and Kaeding 2001). As

more information is obtained, adjustments may be made in the proposed structure of core areas and local population designations.

Belly River Core Area

The entire Belly River drainage within the United States is considered a single primary bull trout core area (Figure 2). The following information describes what is known about existing distribution and movement of bull trout within the Belly River Core Area.

The headwater lakes in the Belly River drainage (including Helen, Elizabeth, Glenns, and Cosley lakes) currently contain a mixed species assemblage of native lake trout and (presumably) native lake whitefish as well as introduced Arctic grayling (*Thymallus arcticus*), rainbow trout, and brook trout. In a 1985 survey conducted by U.S. Fish and Wildlife Service staff, overnight gill nets were set in each of the lakes (USFWS, *in litt.* 1985). No fish were detected in Helen Lake. In Elizabeth Lake, two nets caught 40 Arctic grayling, 29 rainbow trout, and a single brook trout. In Glenns Lake, catch from two nets included 71 fish identified as lake whitefish, six lake trout, one rainbow trout, and one brook trout. A single net set in Cosley Lake (USFWS, *in litt.* 1985) caught 49 fish identified as lake whitefish and 13 lake trout. According to one of the participants (R. Wagner, pers. comm., 2002) inexperience of the crew led to some uncertainty about the identification of fish species they were unfamiliar with, and these waters should be resurveyed. Lake whitefish are not found in the Belly River in Canada upstream from the confluence of the Waterton River (T. Clayton, pers. comm., 2002) and their presence in Glenns and Cosley lake is suspect.

Belly River Redd Surveys

The North Fork of the Belly River originates at Miche Wabun Lake in Glacier National Park. Miche Wabun Falls, about 5 kilometers (3 miles) downstream from the lake, is presumed to be an upstream fish migration barrier. About 2 kilometers (1.2 miles) downstream from Miche Wabun Falls the North Fork Belly River enters Canada and flows another 8 kilometers (5 miles) northeast to the mainstem Belly River. In the United States, bull trout are found in only the 2 kilometer (1.2 mile) reach of the North Fork Belly River downstream from Miche Wabun Falls and upstream from the international border.

Investigation of migratory fluvial bull trout movements and population status was made between 1995 and 1999 in the Belly River in Canada (Clayton 2001). Bull trout spawning was found to occur in only one tributary, the North Belly River. The North Belly River was surveyed for bull trout redds a minimum of twice per year in 1995 through 1999 to assess population status (Clayton 2001).

Redd counts increased every year, and overall they were up 340 percent over the 5 year period, from 27 in 1995, to 119 in 1999 (Clayton 2001). The author concluded the increase indicated an increasing trend in abundance, attributed primarily to protection from angler harvest.

Clayton (2001) also demonstrated that mortality rates of adult bull trout in the Belly River were typically quite low (*e.g.*, less than 16 percent for 57 fish tagged in 1995). He further concluded that irregular spawning (*e.g.*, alternate years) was typical, although there was a great deal of variability in that regard. Six of the fish he studied spawned consecutively for 5 years in a row; including at least four females (Clayton 2001).

Belly River Trapping and Radio Telemetry

A picket weir box-style fish trap was used to intercept bull trout in the North Belly River, approximately 700 meters (0.4 miles) upstream of its confluence with the Belly River, in 1995 through 1999 (Clayton 2001). Both upstream and downstream traps were operational, typically from late August to mid-October or later, in all years but 1997. In 1997, only the downstream trap was installed, from September 12 to October 18. In fall 1996, a two-way trap was also placed in the mainstem Belly River about 1.5 kilometers (1 mile) above the North Belly River confluence and 3 kilometers (2 miles) below the international border; it operated from August 9 to October 22.

Information from bull trout captured in the downstream trap represents the most consistent data set from which to measure population status in the Belly River over the 5 years of study (Clayton 2001). A radio telemetry component of the study showed some bull trout remained upstream of the trap after the trap was removed; therefore the downstream trap numbers are a conservative estimate of spawning bull trout.

From 1995 to 1999, there was a 130 percent increase in the number of bull trout collected in the downstream trap, from 43 to 99 fish (Clayton 2001). The year to year percentage increases varied widely, with both downstream trap captures and overall captures decreasing in 1 of 5 years.

Twenty bull trout heavier than one kilogram (2.2 pounds) were implanted with radio transmitters in September 1997 (Clayton 2001). From October 1997 to October 1999, there were 43 fixed-wing flights conducted along the mainstem Belly River, and 3 helicopter flights up the North Belly River to locate bull trout. Radio telemetry was conducted to determine movement patterns and assess the efficacy of screening on the Mountain View Irrigation District diversion.

Bull trout in the Belly River system are considered fluvial, inhabiting the mainstem for most of the year, but spawning in tributaries. The only bull trout spawning tributary identified in the Belly River drainage was the North Belly River (Clayton 2001). Most radio tagged bull trout that exhibited movements during the spawning season entered the North Belly River. The majority of bull trout migrating to the North Belly River undertook movements from mid-July to mid-August. A few bull trout not entering the North Belly River moved during fall spawning period, but there were never any concentrations of radio tagged bull trout (*i.e*. two or more per site), thus indicating bull trout were not spawning in the mainstem Belly River (Clayton 2001). Also, during aerial surveys of the mainstem Belly River no bull trout redds were observed. There was no suitable bull trout spawning habitat downstream of the North Belly River trap.

Of 16 bull trout with radio transmitters that were tracked over a period of months, 12 had definite home ranges, which they occupied for all but the spawning season (Clayton 2001). The home ranges tended to be about 2 kilometers (1.2 miles) in river length, but these home ranges were based on fixed-wing reconnaissance and not ground-truthed.

Natural blockages to upstream fish movement on the Belly River occur in Montana at Gros Ventre Falls on the Mokowanis River, and at Dawn Mist Falls on the Belly River mainstem (Clayton 2001). At least one radio tagged bull trout was located at the base of

each falls. Seven of the 20 radioed bull trout (35 percent overall) lived primarily on the Montana side of the international border.

Miche Wabun Falls, located about 10 kilometers (6 miles) up the North Belly River and about 2 kilometers (1.2 miles) into the United States, is also a natural blockage to fish passage (Clayton 2001). The primary bull trout spawning area for the Belly River bull trout population is located in a 3 kilometer (2 mile) reach which straddles the international border and has an upper boundary at the falls. Six of the radio tagged fish (five females) spawned in the area in 1998 and 1999.

A 1995 spring flood in the headwaters of the Belly River substantially scoured the stream channel. Because the scouring lowered the active channel into the groundwater zone and contributed extensive deposition of woody debris, it was noted that spawning and rearing habitat in the upper North Fork Belly River was substantially improved over 1994 conditions. The reach of stream immediately downstream from Miche Wabun Falls, which had been intermittent in the low water year of 1994, was noted to flow continuously in 1995 (Fox *et al.* 1996).

The limit of downstream movement of radio tagged bull trout was approximately 10 kilometers (6 miles) below the United Irrigation District weir, which is 30 kilometers (19 miles) below the confluence of the mainstem Belly and North Belly rivers (Clayton 2001). Most of the bull trout home ranges in the main Belly River were located in a 22 kilometer (14 miles) reach, centered on the North Belly - mainstem confluence (*i.e*. 11 kilometers or 7 miles each way). The home ranges of the 16 radio tagged bull trout were dispersed throughout the upper mainstem of the Belly River in Canada and extending into the United States.

The radio telemetry data from both fall 1998 and 1999 provided insights into bull trout post-spawning downstream migration. The majority of radio tagged bull trout emigrated out of the North Belly River by the end of September (Clayton 2001). However, some adult fish continued to reside in the North Belly into November. In 1998, the downstream trap was pulled in mid-October. These bull trout were well upstream of the trap, indicating that trap avoidance had not caused the extended residence. These data

demonstrated that the number of fish in the downstream trap was a conservative estimate of the total number of spawners.

Analysis of length frequency histograms over the 5 years of study suggested that bull trout growth in the Belly drainage is similar to that reported for the Saint Mary (Montana) drainage.

Based on the 1995 initial tagging, Clayton (2001) estimated 20 percent annual mortality for adult bull trout occurred in the Belly River in the mid-1990's. Since that time angling regulations were changed to a zero bag limit (1995) and vertical bar screens were installed (1999) at the Mountain View Irrigation District headgates. Both of these measures were expected to reduce known sources of mortality. While fish losses via the Mountain View Irrigation District canal into Payne Lake did not always result in direct mortality, these fish were reproductively lost to the Belly River drainage. Some fishing mortality to bull trout (*i.e*. hooking mortality, poaching, misidentification) will continue as anglers continue to fish in the Belly River drainage for bull trout and other species.

Most bull trout in the Belly River drainage don't migrate over large distances to reach their spawning areas. Bull trout in Clayton's (2001) study did not move downstream into the lower reaches of the Belly River. Genetic analysis indicates that bull trout in the Belly River differ substantively from bull trout found in other portions of the Oldman River drainage (Thomas *et al.* 2001), an indication that long-term reproductive isolation has occurred. Belly River bull trout seem to be dependent upon a single local population in the spawning reach of the North Belly River. Thus, the upper Belly and North Belly Rivers are considered a single core area. Survey work in high priority watersheds in the upper Belly River drainage in Glacier National Park should continue to focus on determining distribution and population abundance.

REASONS FOR DECLINE

Dams

Saint Mary River

Two major storage dams are located in the Saint Mary River drainage. Swiftcurrent Creek was dammed near the boundary between Glacier National Park and the Blackfeet Reservation in 1920, forming Lake Sherburne. The reservoir has a maximum surface area of 648 hectares (1,600 acres) and storage capacity of nearly 84 million cubic meters (68,080 acre-feet) of water (see earlier description for more details).

Saint Mary Reservoir was created by a dam constructed on the Saint Mary River near Cardston, Alberta in 1946. The dam is 56.4 meters (185 feet) high, with a full pool surface area of 3,764 hectares (9,300 acres) and a storage capacity of about 370 million cubic meters (300,000 acre-feet) in the reservoir (T. Clayton pers. comm., 2002). In late summer 2001, the reservoir was drawn down to only 2 percent of storage capacity (T. Clayton pers. comm., 2002), resulting in a pool with maximum depth of 27.5 meters (90 feet).

While there have been major impacts to bull trout in the system associated with these dams, neither is located in an area where fish passage is believed critical to recovery of migratory bull trout. Evidence indicates that the Swiftcurrent Creek drainage was historically likely not occupied by bull trout, perhaps due to natural barriers that minimized access to potential spawning and rearing habitat in the headwaters. Cracker Lake, discussed previously, may be an exception. Additionally, the presence of numerous lakes in the Swiftcurrent Creek drainage, the lowermost of which held populations of native northern pike, likely created unsuitable naturally warm summer water temperatures for bull trout in lower Swiftcurrent Creek. U.S. Geological Survey data indicate that summer stream temperatures in Swiftcurrent Creek, taken at the stream gaging station downstream

of Sherburne Dam, often exceed 15 degrees Celsius (59.0 degrees Fahrenheit) and have reached as high as 18 degrees Celsius (64.4 degrees Fahrenheit) (USGS 2002).

The dam on Saint Mary Reservoir, in Alberta, Canada, could have interrupted the migratory corridor for fluvial bull trout in the lower Saint Mary River. However, there is little evidence that migratory fish were common in the Saint Mary River downstream from the current dam site. Migratory fish would have likely used Lee Creek, and perhaps other tributaries, for spawning and rearing. Currently, bull trout occasionally occur in the lower Saint Mary River (probably those that pass over the dam) and are essentially lost to the population. Due to continuing habitat impacts from agriculture and development, and warmer summer water temperatures associated with discharge from the reservoir, the lower portions of the Saint Mary River (downstream from Saint Mary Dam in Alberta) are considered unsuitable habitat for bull trout.

Due in part to the dam forming Saint Mary Reservoir, it is also unlikely that Lee Creek can be restored to its historical status (1930's) as a major migratory spawning stream. Due to largely unsuitable habitat and water temperatures as well as extreme water level fluctuation, adult bull trout are only occasionally found in the reservoir. Because the Lee Creek confluence with the Saint Mary River is just upstream of the reservoir, it is likely that the dam has caused a major reduction in the Lee Creek migratory run. However, it is possible that remnants of that run may persist.

The existing impact to bull trout from Sherburne Dam is primarily related to its use as a water delivery system to a complex series of canals and diversions used for irrigation. These impacts are discussed in detail under agricultural practices, to follow.

Additional alterations to thermal patterns and the water quality regime of the Saint Mary River system, due to discharge patterns from Sherburne Dam, are likely but have not been quantified. The high volume of water released in irrigation season may significantly alter natural water temperatures in Swiftcurrent Creek and

downstream receiving streams, seasonally cooling or warming the water from natural patterns. The effects of those temperature changes on bull trout movements and habitat suitability are unknown.

The Blackfeet Tribe has previously expressed support for consideration of removing Sherburne Dam and restoration of the natural streamflow conditions (Missoulian, *in litt*. 1999), but to date no critical evaluation of that option has taken place.

The recent instability in energy markets has created renewed interest in retrofitting existing dams with hydropower potential. In the summer of 2001 Symbiotic Company filed a notice with the Federal Energy Regulatory Commission applying for a preliminary permit for hydroelectric conversion at Sherburne Dam (Inter Lake, *in litt*. 2001). The project would construct a 137 meter (450 foot) penstock and associated powerhouse to produce 1 megawatt of electricity. Construction would require a lengthy Federal permitting process, and current status of the application is unknown.

Belly River

There are no major dams in the headwaters or on the mainstem of the Belly River in the United States. A series of water diversion structures downstream in Alberta, discussed with agricultural practices later in this plan, have had negative impacts on fish migration and connectivity. Impacts are due to dewatering, flow manipulation, and entrainment in canals. None of those structures represent permanent fish passage barriers.

Forest Management Practices

Historically, the Saint Mary and Belly river drainages have not been a major producer of wood products. The extreme environmental conditions which occur on the east front of the Rocky Mountains; which include bitter winter weather, limited moisture and topsoil, and frequent high winds; limit the potential for growth of commercially viable timber. Much of the area is in a transitional zone from forest toa shrub and grassland habitat type and is forested with deciduous aspen and

cottonwood stands of currently marginal economic value. Access is often steep and difficult.

Past impacts to fish habitat from forest practices have been mostly localized, and occurred primarily as a result of road construction. The watersheds in the national parks have not been logged. On the Blackfeet and Blood reservations substantial forest reserves do occur, but they have not been extensively harvested. The Blackfeet Nation has adopted a moratorium on clearcutting. Pressure to exploit Reservation timber resources may mount with changes in supply and demand. Past logging on Divide Creek on the Blackfeet Reservation in the Saint Mary drainage has contributed to the instability of that watershed. Areas in the East Fork and Middle Fork of Lee Creek have been affected by past logging practices. At least one culvert on the Middle Fork of Lee Creek is a fish passage barrier, with bull trout captured downstream but not upstream from that location (Mogen and Kaeding 2001). In Canada, similar localized problems occur at sites such as on Tough Creek, a tributary to Lee Creek just north of the border (T. Clayton pers. comm., 2002). Demand for firewood has also caused some localized tree harvest in riparian areas.

Generally, the torrential spring flows of these headwater streams has precluded the use of culverts for road crossings. Where they were used, they often blew out and were replaced by bridges.

A major fire occurred in the Saint Mary area in 2002. The potential for fire to impact bull trout is generally low, but may be increased in the future if catastrophic fires occur due to high fuel loads. There are also important relationships between fire and the recruitment of woody debris that may affect bull trout habitat.

In summary, forestry management has some potential to negatively affect bull trout habitat in the Saint Mary - Belly River Recovery Unit, but is not considered a high risk overall.

Livestock Grazing

At present there are limited numbers of domestic livestock in the upper portions of watersheds in the Saint Mary and Belly river drainages. The remoteness of most locations makes herding of livestock difficult and losses to predators are common. A severe early spring storm in 2002 reportedly caused the death of some 3,000 cattle in the area. Glacier National Park does not allow grazing by domestic livestock. However, trespass by domestic livestock in Glacier National Park does occur, and on occasion some riparian areas are grazed by pack stock. Witnesses have often observed trespass cattle in the streambed in the lower Otatso Creek and Kennedy Creek drainages well inside Glacier National Park. In at least one reported case, bull trout spawning areas may have been impacted. A few sites outside Glacier National Park have experienced overgrazing in the past (*e.g.*, Middle Fork and East Fork Lee creek). There is some concern that in the future there may be increasing pressure to develop the livestock industry and/or increase bison or elk herds on Reservation lands. If grazing fees increase on Federal lands, grazing of Tribal lands could become increasingly cost effective. In general, grazing by domestic livestock has not been a major factor in the decline of bull trout in the Saint Mary - Belly River Recovery Unit.

Agricultural Practices

Saint Mary River

Beginning in 1902, and extending through at least 1921, the U.S. Bureau of Reclamation built several water-control and delivery structures in the Saint Mary River drainage, as part of the Milk River Irrigation Project (Mogen and Kaeding 2001). At the outlet to Lower Saint Mary Lake, a U.S. Bureau of Reclamation diversion structure was constructed. An article in the Kalispell Inter Lake, on April 18, 1902, touted the need for such a diversion:

> "These St. Mary lakes receive the drainage from the high peaks of Rocky mountains, but instead of continuing easterly across the plains as the rivers do further south the waters overflow northerly by St. Mary's river to the

Saskatchewan river and are lost in the Hudson Bay. The eastern course, which appears to be the original or natural direction for the waters to pursue has been blocked by the glacial debris left near the foot of the mountains. The proposed canal will restore what may be called the original preglacial drainage." (Inter Lake, *in litt*. 1902).

Initial plans for the Milk River project were prepared by the Reclamation Service and submitted for approval by the Secretary of the Interior on July 8, 1902, only a few weeks following the formation of the Reclamation Service (Milk River Project, *in litt*. 2000). On March 14, 1903, the Secretary of the Interior authorized construction of five U.S. Bureau of Reclamation irrigation projects, including the Milk River Project. On March 25, 1905, $1 million was allocated for construction of storage works on the Saint Mary River and facilities to divert water from the Saint Mary River to the North Fork of the Milk River. In 1906 the Reclamation Service was authorized to draw up specifications and advertise for bids to construct the Saint Mary Canal from the Saint Mary River to the Milk River. Construction began in 1906 (Inter Lake, *in litt*. 1906).

Water stored in Lake Sherburne runs down the Swiftcurrent Creek channel to the lower end of Lower Saint Mary Lake. About 1 kilometer (0.6 miles) downstream of the outlet of Lower Saint Mary Lake the water is diverted into the Saint Mary Canal and then transported 47 kilometers (29 miles) to the North Fork of the Milk River, which conveys the water 348 kilometers (216 miles) through Canada before returning to the U.S. (Milk River Project, *in litt*. 2000). Milk River Project water is stored behind Fresno Dam, located northwest of Havre, Montana, and off- stream in Nelson Reservoir northeast of Malta, Montana. Releases are made into the Milk River from Fresno Dam and diverted near Chinook and Harlem, Montana, into private canals to irrigate about 15, 096 hectares (37, 273 acres) of cropland (Milk River Project, *in litt*. 2000). Additional diversion occurs near Dodson, for Nelson Reservoir, and irrigates another 17,207 hectares (42,487 acres) of crop land in the Malta Division. Finally, Vandalia Diversion irrigates about 7,294 hectares (18,011 acres) in the vicinity of Glasgow, and the Dodson Pumping Plant lifts water to irrigate about 5,077 hectares (12,535 acres). Thetotal area irrigated in the United States by the Milk River Project,

which is heavily dependent on Saint Mary River input, is about 44,550 hectares (110,000 acres).

Other water-control and delivery structures have been built in Alberta (Mogen and Kaeding 2001). A diversion dam located about 20 river kilometers (12 river miles) downstream from the international border, that diverted water from the Saint Mary River into the Kimball Irrigation Canal, washed out a few years ago and was not rebuilt. It is no longer viewed as a passage or entrainment problem for bull trout.

The numerous diversions in the system continue to pose migratory barriers for fish. Saint Mary Diversion Dam was previously suspected to be at least a seasonal barrier. In reaching the decision to list the bull trout as a threatened species, the U.S. Fish and Wildlife Service concluded, in part, that bull trout in the Saint Mary River drainage are negatively affected by operation of the water-storage and delivery systems that are part of the Milk River Irrigation Project (USFWS 1999). Results of Mogen and Kaeding's (2001) 4-year study support several of the U.S. Fish and Wildlife Service conclusions, including that bull trout are entrained in the Saint Mary Canal. Because the canal headgates are velocity barriers to the upstream movement of fish, bull trout that enter the canal system are unlikely to be returned to the river and are therefore removed from the reproducing population, if not actually killed. Recent results from both radio telemetry and conventional tag-recapture techniques indicate there is considerable upstream and downstream movement of adult bull trout over the diversion (Mogen and Kaeding 2001). Timing of those movements is not known precisely, but probably occurs outside the irrigation season when the dam is open, usually between October and April. The Saint Mary Diversion Dam is now considered a partial migration barrier, which could significantly interrupt spawning migrations.

In addition, results from radio telemetry suggest that the acute annual reductions in discharge into Swiftcurrent Creek from Sherburne Dam, which typically occur at the end of the irrigation season, produce dewatered conditions downstream in Swiftcurrent Creek that directly or indirectly result in the death of bull trout (Mogen and Kaeding 2001). Soon after being implanted with radios

inBoulder Creek, two bull trout swam a short distance up Swiftcurrent Creek. Subsequently, in the fall 1998, flows from Sherburne Dam were turned off and those two fish were stranded in shallow pools, where they subsequently perished under the ice. Another fish, originally radioed in Boulder Creek in October 1998, ascended Swiftcurrent Creek later in the fall of 1998 before flows were reduced. That fish wintered in an outlet tunnel of Sherburne Dam. It was located again in February 2001, inside Sherburne Dam, and then moved downstream. It subsequently crossed the international border several times in the summer of 2001.

Gillnetting was conducted in the Saint Mary Canal during mid-October 1999 to assess fish loss to the canal system (Mogen and Kaeding 2001). Experimental gill nets were set after the irrigation season had ended and canal flows were substantially reduced. A total of nine experimental gill net sets made at six different locations along the first 2 kilometers (1.2 miles) of the Saint Mary Canal yielded 295 fish, including 6 bull trout (Mogen and Kaeding 2001). In addition, the two outlet tunnels in Sherburne Dam were seined on September 28, 1999, while the dam was closed and the water in the tunnels had been drawn down for dam repairs. One bull trout was captured (Mogen and Kaeding 2001).

Belly River

A series of three major irrigation diversion weirs on the Belly River in Canada have historically restricted migratory movements. The Mountain View Irrigation District diversion is the furthest upstream (Figure 3), located about 170 River kilometers (106 River Miles) upstream from the confluence of the Belly River with the Oldman River and 6 kilometers (4 miles) downstream of the North Belly River confluence with the mainstem Belly (approximately 10 kilometers or 6 miles north of the international border). The Mountain View Irrigation diversion has been in operation since 1935 (Fox *et al.* 1996) and does not contain a fish ladder, but the structure is low enough that some upstream fish passage is likely at most flows (T. Clayton pers. comm., 2002). Bull trout entrained in the Mountain View Irrigation District canal were sometimes caught by anglers at Payne Lake, an offsite storage reservoir downstream. Fish moving into the canal are precluded from returning to the river.

Radio telemetry studies shed some light on what was, until recently, a serious entrainment problem in the Mountain View Irrigation District canal. In 1997 three of 20 radioed bull trout (15 percent) had become entrained in the Mountain View Irrigation District canal system (Clayton 2001). Two of the three fish successfully navigated the canal to Payne Lake, while the third died in the canal (Clayton 2001). A fourth bull trout was entrained in the canal in May 1998. Two of the radioed fish were caught by angling in May 1998, in the canal system, and released back into the mainstem Belly River. One of these fish spawned in fall 1998, while the other remained in the mainstem Belly River. By late September, both of the fish caught and released in May were again entrained in the Mountain View Irrigation District canal system.

Vertical bar screens were installed in the Mountain View Irrigation District headgates in spring 1999, and there were not any radio tagged bull trout entrained in the Mountain View Irrigation District canal system in 1999. In addition, no tagged bull trout captured in the 1999 Belly River studies were collected during fish recovery efforts in the canal at the end of the irrigation season. Thus, while effectiveness remains largely undocumented, there is evidence the entrainment problem in the Mountain View Irrigation District canal has been substantially resolved.

Especially significant to bull trout is the next downstream diversion, the United Irrigation Diversion weir. It was constructed in 1923 near Hillsprings, about 146 river kilometers (90 miles) upstream from the Belly and Oldman river confluence (about 35 kilometers or 22 miles north of the international border) (Figure 3). The United Irrigation District diversion has posed fish passage problems since its construction. The United Irrigation District weir underwent an upgrade in the early 1990's. However, despite the incorporation of a fishway, it still does not effectively pass upstream migrating fish during the summer irrigation season due to problems with the location of the fishway and insufficient attraction flows. Outside

the summer irrigation season (when water is not being diverted into the canal), the entire stream flow passes through a gated structure (instead of

overtopping the United Irrigation District weir), which does provide fish passage. The net result is that upstream migrating bull trout (and other fish) are held up at the diversion for the entire summer irrigation season. Bull trout thus delayed may ultimately be precluded from reaching their spawning grounds during that year, though may succeed in following years if they pass through in the offseason (T. Clayton pers. comm., 2002). Habitat conditions for bull trout in the Belly River, downstream from the United Irrigation District diversion, are marginal during the summer with the influence of irrigation withdrawals, reduced habitat, and elevated water temperatures.

The 24 kilometer (15 mile) reach of river between United Irrigation District and Mountain View Irrigation District diversions is fairly remote. Above the Highway 5 bridge crossing, where most of the suitable overwintering habitat for fluvial bull trout in the Belly River system occurs, approximately half the streambank is forested with the other half grassland. Approximately half the streambanks in this reach are unstable (T. Clayton pers. comm., 2002). Downstream from the Highway 5 bridge crossing, the streambanks consist mostly of grassland in open range. The river channel is moderately unstable and lateral movement is evident in the valley floor.

The lowermost diversion, downstream from United Irrigation District, is linked to canals which transport water from the Waterton River to Saint Mary Reservoir (Fox *et al.* 1996). Water is conveyed about 10 kilometers (6 miles) to the Belly River from Waterton Reservoir, an impoundment on the Waterton River. After using the Belly River as a conduit for 1 kilometer (0.6 miles), a diversion dam on the Belly River diverts water into another canal, which transfers the water about 40 kilometers (25 miles) to Saint Mary Reservoir (Figure 3).

Diversions on smaller streams such as Lee Creek are also likely barriers to migratory bull trout, and may have been major factors in the decline of bull trout in southwestern Alberta.

In summary, impacts from agriculture in the Saint Mary and Belly River watersheds are mostly due to dewatering and migratory disruption caused by diversion dams and canal systems. Major projects on the Saint Mary were constructed beginning

as early as 1902 at Lower Saint Mary Lake, and in Canada at Saint Mary Reservoir in 1946, converting relatively pristine watersheds to dewatered and regulated streams. Impacts to these systems occurred prior to any inventory data, so the true effect on bull trout populations will never be known. Severe dewatering remains commonplace, especially in Canada, with most of the water routed through lengthy canal systems to the east. Any return flows from U.S. diversions are routed into the Milk River system. Irrigation system impacts remain as high risk factors to bull trout in the Saint Mary - Belly River Recovery Unit.

Transportation Networks

Historically, railroads did not impact the Saint Mary and Belly River drainages to any major extent and much of the basin remains roadless. Many of the transportation corridors along streams were developed a century ago for access to the National Parks. A portion of the Many Glacier Highway invades the riparian area of Swiftcurrent Creek and some county roads in the drainage have also been problematic. Additional road network issues occur on Divide Creek. Overall, while there are places where impacts of individual projects to bull trout have been substantial, the cumulative effects currently are not a major threat to bull trout.

Mining

Mineral exploration occurred along much of the eastern Rocky Mountain front around 1900, and even earlier, before the existence of Glacier National Park. The effects on native fish populations, due mostly to the impact of miners and their settlements are not well documented. Morton (1961) recounted the following history of Cracker Lake, in the Saint Mary River headwaters, in what is now Glacier National Park:

> "Canyon Creek is boulder strewn, with streches (sic) of foaming water between deep pools. As it has no falls, fish can swim upstream, but it has gained little acclaim for fishing. Before the establishment of Glacier National Park, in the days of prospecting and mining, the Many Glacier area was a scene of much hustle and bustle. Besides prospecting near Mt. Wilbur, there was much activity along Canyon Creek. A wagon road t Cracker Lake was built at great expense,

> and a costly crusher was installed there. The venture died since it did not pay, but the wagon trail remained for those who came later in quest of Nature's richer beauty."

Mogen and Kaeding (2002) confirmed these observations that fish passage up Canyon Creek appeared possible.

As documented by Fitch (1997) the trend for bull trout populations in the Saint Mary, Belly, and Waterton river drainages in Alberta has been downward since recorded history in the 1920's and 1930's. Particularly sharp population declines were believed to have occurred in the 1960's, when major water projects and oil and gas exploration projects were most intense (Fitch 1997). The range of bull trout in some of these drainages was believed to have been reduced by 70 to 80 percent, primarily due to loss of distribution in the lower portions of major stream systems. While population abundance was not assessed, it is safe to assume that abundance also declined.

Oil and gas exploration opened up a maze of roads and trails in the Canadian portions of the Belly and Waterton river drainages, contributing to watershed instability. More importantly, vehicle access caused associated problems with overfishing, illegal angling, associated power and utility corridors, etc. Active gas fields in the Belly and Waterton river drainages have the potential for causing effluent discharge. The waters in the region are poorly buffered and acid discharge and acid rain from sour gas processing are concerns for both air and water quality. Consequently, mining is considered an ongoing risk to bull trout in the Belly River drainage. Similar concerns exist, but to a lesser extent, in the Saint Mary River watershed.

Residential Development and Urbanization

A low density of human occupation occurs in the Saint Mary River and Belly River drainages, along with a high percentage of public land. While the region does see a high volume of human traffic due to tourists in the two national parks (several million visitors annually), most of the human occupation is seasonal in nature and development is clustered. Rural residential development (subdivision) has not been, and probably

will not be, a major risk factor to bull trout populations in the Saint Mary River and Belly River drainages.

A few problem areas do exist due to the poor placement of some of the existing developments. One of the worst is on Divide Creek at Saint Mary, where inappropriately located development straddles an active riparian zone and forces channelization of the stream to remove bedload buildup. Traditionally, national parks have taken a "softer" approach to development and problems with recreation are due more to cumulative impacts of heavy use on trails, roads, and riparian zones than to individual projects.

Portions of the Blackfeet and Blood reservations on the Saint Mary and Belly rivers have the potential to become prime recreational development property. The Blackfeet Nation has a developing conservation easement program, promoted in part by the U.S. Fish and Wildlife Service Partners program, to protect some of these sensitive lands.

Fisheries Management

Saint Mary River

The occurrence of natural, year-round barriers to the movements of fish, along with the stocking of nonnative fish species, greatly influenced the historical and contemporary distributions of fishes in the Saint Mary River drainage (Mogen and Kaeding 2001). Waters upstream from those year-round barriers that were historically barren of fish include the upper Red Eagle, Swiftcurrent, Kennedy and Otatso creek watersheds, and the headwaters of the Saint Mary River itself.

Morton (1961, 1964) recounted the history of fisheries management in Glacier National Park. In general, it consists of extensive efforts to improve upon the native fishery, primarily through the liberal use of fish stocking. The fish stocking effort began well before Glacier National Park was created in 1910.

Stocking of both nonnative and native fishes in the Saint Mary River drainage began in the late 1890's and continued in Glacier National Park until the mid-20th

century. Some of the earliest efforts at fish stocking were performed by individuals who obtained fish by application to the U.S. Bureau of Fisheries (precursor to the U.S. Fish and Wildlife Service) with sponsorship of a U.S. Senator (Morton 1964). Most of those fish plants were not recorded. From 1912 to 1917, the Great Northern Railway was quite active in stocking waters on the east side of Glacier National Park, with fish secured from the State of Montana and the U.S. Bureau of Fisheries (Morton 1964). The purpose was to improve fishing and attract more customers to the Great Northern chalets, hotels, and trains. In 1915, the Superintendent of Glacier National Park first requested and received fish for stocking (Morton 1964).

Nearly a million fish had already been stocked in the waters of Glacier National Park by 1919, when the Glacier Park Fish Hatchery located at East Glacier went into operation. In 1921 to 1923, nearly 2 million fish per year were stocked in Glacier National Park waters, and by 1926 over 3 million. The peak was 4.5 million in 1932. Most of the cutthroat trout stocked between 1920 and 1940 in Glacier National Park waters were propagated from eggs supplied by the State of Montana and the Yellowstone Trout Hatchery. These fish were primarily nonnative Yellowstone cutthroat trout, known as 'blackspotted' trout at that time. The Glacier Park Fish Hatchery at East Glacier was abandoned about 1940 when Glacier Park National Fish Hatchery at Creston became operational.

During the period 1912 through 1944 Morton (1964) documented that the following number of different fish species were stocked in Glacier National Park (includes all drainages parkwide):

29.8 million "blackspotted" fry (Yellowstone cutthroat trout)
2.4 million blackspotted eggs
7.6 million rainbow trout fry
5.0 million arctic grayling fry
3.4 million brook trout fry
500,000 Lake Superior whitefish fry
350,000 "salmon trout" fry* (chinook)
66,000 golden trout fry
58,000 steelhead fry
51,000 mackinaw fry (lake trout)

13,000 landlocked salmon (Atlantic salmon) - Saint Mary Lake in 1931

*A curious stocking record for Swiftcurrent Lake, in 1916, lists 8,750 Sal. Tr. (Morton 1961). Another plant of the same size and species occurred in Lake Josephine. Morton interpreted these records to be plants of kokanee, although he reported they were labeled "chinook" salmon. However, since bull trout were commonly known as Salmon Trout during that era, the record needs further explanation. If these fish were bull trout, it could mean bull trout were propagated in hatcheries and planted in the area, possibly explaining the appearance of bull trout in Cracker Lake, as well.

The total number of fish stocked, from the above list, approaches 50 million over a 32-year period - a staggering total given the inherent rearing capacity of Park waters. Government fish stocking efforts in Glacier National Park generally peaked in the 1920's and early 1930's. Even though most of these plants occurred in headwaters of the Columbia River or Missouri River drainage, and not in the Saint Mary or Belly rivers or their drainages, fish plants in the Saint Mary - Belly River Recovery Unit were substantial.

Glacier National Park National Fish Hatchery, near Kalispell, was authorized in 1939 and built in 1940 for the sole purpose of stocking fish in Glacier National Park (Fredenberg 1997). With the Creston facility available, it was intended that fish stocking in Glacier National Park would be further expanded. In the 1940's numbers were reduced, but size of fish stocked was increased. However, in 1944, the hatchery was transferred to the U.S. Fish and Wildlife Service and by 1945 the era of fishstocking in Glacier National Park began to wind down. After 1952, only fingerling sized fish were stocked, and generally fewer than 100,000 per year.

This fish stocking activity left a legacy of introduced sport fish species in watersheds that already had a relatively diverse native sport fish fauna consisting of bull trout, westslope cutthroat trout, lake trout, and northern pike. Nonnative fishes that have now established self-sustaining stocks within the Saint Mary drainage include Yellowstone cutthroat trout, rainbow trout, and the hybrids (*i.e.* fish of various generations that have resulted from the interbreeding among first generation hybrids, their parent stocks, and subsequent backcross progeny) of those two fishes, as well as

brook trout and kokanee. Donald and Stelfox (1997) pointed out that in order for adfluvial populations of bull trout to be maintained, stocking with lake trout or brook trout should not be permitted. Generally, agency fish stocking policies in the Saint Mary - Belly River Recovery Unit are now quite restrictive. Over time, some of the waters in Glacier National Park and Waterton Lakes National Park may be reclaimed for native species.

Fisheries management and biological surveys played a major role in changing the fish stocking policies. In 1935, A.S. Hazzard, Associate Aquatic Biologist of the U.S. Bureau of Fisheries submitted a comprehensive report of fishery investigations in Glacier National Park from 1932 and 1933 (Morton 1964). He advised Glacier National Park to designate and enforce size and number limits and spawning closures, reduce stocking of back country waters, avoid warm water fish introductions, and use marked fish plants to assess the value of stocking (Morton 1964).

With regard to early stocking of nonnative species in Park waters, Morton (1961) recounted the thoughts of Hazzard (1935):

> "It is our opinion that the great majority of the waters of Glacier National Park are best adapted to the Native Cutthroat trout. This seems especially true of the lakes and streams west of the divide. Certain waters of the east side have been planted with exotic species and in a number of cases these are believed to have been wise introductions. The introduction of eastern brook trout into the Two Medicine and Swiftcurrent drainages may be deplored by some but this species furnishes the majority of the catch in these waters and requires relatively little assistance from man due to unusually successful natural spawning."

In a meeting held at Park Headquarters on July 15, 1950, Glacier National Park and U.S. Bureau of Sport Fisheries and Wildlife officials in attendance agreed that many years of heavy fish stocking had failed to produce notable results and a new approach was needed (Morton 1964). The Glacier National Park Superintendent emphasized two goals: (1) "Angler catches would one day be composed only of native wild fish uncontaminated by introduced species or races", and (2) "Glacier National Park waters were to be studied to ascertain their species complexes, biological potential, and what

could be done to enhance the best interests of both preservation and angler use" (Morton 1964). Biologists O.L. Wallis of the National Park Service and W.M. Morton of the Bureau of Sport Fisheries agreed that the first goal was a long- range aim that would be difficult to attain in view of the fact that practically all Park waters had been stocked and most east slope waters were historically fishless (Morton 1964). Progress on the second goal was slowed by a shortage of manpower, but resulted in a series of fishery management reports by Morton in 1961 through 1968.

On the Blackfeet Reservation, fishing was not a traditional activity and most of the streams were too remote to be heavily fished. The nature of the drainages (high gradient with natural fish barriers in the headwaters), makes it likely that natural concentration points for fish occurred. Barrier water falls or other fish passage blockages may have enhanced the opportunity for fish harvest, but there is little historical evidence that routine fish harvest by Native Americans occurred in this recovery unit. The legal harvest of bull trout on the Blackfeet Reservation was precluded by new fishing regulations beginning April 1, 2000.

The following is a drainage by drainage analysis of the historical and existing condition of the fishery, and discussion of the relative importance of some of the limiting factors.

Saint Mary Lakes

Nearly nothing is known about the status, distribution, and life history attributes of bull trout that occupy Saint Mary Lake. Lower Red Eagle Creek was purported to have been a concentration area for large bull trout. This lack of information represents a major research need for this drainage.

While sport fish angling on these waters is generally light, traditional and historical use of lake whitefish from the Saint Mary lakes has occurred off and on through a commercial fishery. Morton (1964) described how in May, 1913, the Glacier National Park Hotel Company was given permission to seine 16 kilograms (35 pounds) of whitefish daily from Saint Mary Lake to serve to their guests. The permit was subsequently revoked when an unattended net was discovered. However, the permit was soon restored and netting by the hotel company continued at least into the 1930's

(Morton 1964). Local lake whitefish has traditionally been served at the Saint Mary Lodge for most of the past century.

The Blackfeet Nation has authorized two commercial fishing permits for Tribal members to gill net lake whitefish from lower Saint Mary Lake. There has been some effort to track the catch, but records are incomplete. In 1994, the most recent year for which records were available, the two permittees reported a total catch of 4,531 lake whitefish, 750 white suckers (*Catostomus commersoni*), 122 burbot, 106 lake trout, 77 westslope cutthroat trout, 19 northern pike, and 19 bull trout (Blackfeet Nation, *in litt*. 1995). Bull trout caught in the nets were released. Their survival rate was unknown, but likely low. Depending on the timing, location, and level of effort of commercial netting, there could be substantial impacts to bull trout recovery. Alternative methods of whitefish harvest that are potentially less harmful to bull trout should be evaluated and employed.

In recent years fish stocking has continued sporadically in Lower Saint Mary Lake. Approximately 10,000 westslope cutthroat trout were planted in 2000, from Creston National Fish Hatchery.

Divide Creek Drainage

There is also little historical information available to describe the fishery of Divide Creek.

Boulder Creek Drainage

Boulder Creek was noted by Morton (1961) to be a drainage with a notable lack of historical fishery information. According to Morton (1961), Brooks reported in 1921 that Boulder Creek had only native cutthroat and bull trout. Glacier National Park records showed 19,000 cutthroat were stocked in Boulder Creek in 1921 (Morton 1961).

In 1985, as part of an experimental program, the U.S. Fish and Wildlife Service stocked nonnative Yellowstone cutthroat trout in Flattop Lake. This small lake is in a side drainage of lower Boulder Creek on the Blackfeet Reservation (Dwyer *et al.* 1990). A reproducing population of Yellowstone cutthroat trout is now well established, along with an unauthorized introduction of lake chubs (*Couesius plumbeus*). Because

Yellowstone cutthroat may hybridize with native westslope cutthroat, the U.S. Fish and Wildlife Service is planning to remove the population. Potential implications to bull trout include the possibility of competition with more piscivorous Yellowstone cutthroat trout, as well as potential to attract additional angler use in an important drainage for bull trout spawning and rearing.

Swiftcurrent Creek Drainage

Morton (1961) noted that two natural water falls between the upper end of Lake Sherburne and Swiftcurrent Lake blocked upstream migration of fish. He provided a geological description of the falls and its origin, and stated "there were - nor are - no known 'native' species of fish in the waters above these falls. Thus, it is quite a safe assumption that the many lakes above these falls had no fish until Glacier National Park, and its immediate predecessors - mostly mining prospectors - introduced them into these waters." That point of view was reinforced by an article in the Kalispell Inter Lake, in 1903, which recounted a mountain trip in the area and referred to Swiftcurrent Lake as "Lake McDermott", describing it as a "beautiful body of water, elevation 4861, three-fourths of a mile long and one half mile wide, and as luck would have it there are no fish, as there is a fall at the outlet 75 or 80 feet high" (Inter Lake, *in litt*. 1903). The Inter Lake further noted that the area of the falls: "would be a grand place for a dam for storage" inundating Lake Josephine and Grinnell Lake and creating "a great fish pond" (Inter Lake, *in litt*. 1903).

The artificial reservoir of Lake Sherburne inundated two natural lakes in the valley floor. Brooks (1921), as cited by Morton (1961), described the native fish species in the basin as follows:

> "Pike or Great Northern Pike, Pickeral or Musculonge (northern pike), Hudson Bay Whitefish (lake whitefish), Black-spotted Trout (cutthroat), and possibly other varieties of native fish are found in Lake Sherburne and Swift Current Creek."

If bull trout were native in the Swiftcurrent Creek drainage, their presence was not directly noted by these early writers. It is possible they were not present, or were at least limited in numbers, perhaps as a result of unsuitably warm natural summer water temperatures from the lake systems and the presence of barrier falls upstream.

Nonetheless, the possible historical presence of bull trout in the Swiftcurrent Creek drainage cannot be categorically excluded.

The presence of bull trout in Cracker Lake is an intriguing and possibly unique situation. The lake surface occupies only about 20 hectares (50 acres), at an elevation of 1,753 meters (5,750 feet) above sea level (Morton 1961). In 1921 Brooks noted there were fish present in Cracker Lake (Morton 1961), but was uncertain as to the species, stating: "A small species of native trout, possibly the cutthroat, is present in this lake." These fish may have been bull trout. Subsequently, Hazzard in 1935 recommended rainbow trout plants in the lake and by 1941 Schultz noted that rainbow trout, cutthroat trout, and Dolly Varden were present, all as a result of stocking (Morton 1961). However, bull trout are the only species known to be present in the lake at this time. In a 1960 creel census report it was noted that "some anglers caught 20 dolly varden, 7 to 9 inches long, in 4 hours fishing", with the comment: "Fish were very hungry, skinny and overstocked - lake needs more fishing pressure." (Morton 1961). Cracker Lake may represent the only place in the U.S. range of bull trout where a self-sustaining introduced population of bull trout occurs, although the possibility exists that these fish were native.

Morton (1961) recounted the stocking of kokanee in Swiftcurrent Lake as recorded by Schultz in 1941: "The little redfish were introduced into Swiftcurrent Lake and during 1932 adults were taken which were nearly ready to spawn." Glacier National Park records indicate nearly 2 million fish were stocked in Swiftcurrent Lake between 1912 and 1961, the vast majority brook trout and rainbow trout. In addition, some cutthroat trout and Arctic grayling were stocked, particularly in the 1910's and 1920's.

Extensive voluntary angler creel survey records from Swiftcurrent Lake in 1959 and 1960 indicated a low return rate on stocked rainbow trout and the stocking program was subsequently discontinued (Morton 1961). Several records showed bull trout in the catch, but the authorities believed they were misclassified brook trout catches. At least three gill net surveys conducted in the lake in 1959 and 1960 failed to detect bull trout (Morton 1961).

Kennedy Creek Drainage

Brooks, in 1921, noted that cutthroat trout and bull trout were native to the South Fork of the Kennedy River (Morton 1961) and stated that they might occur in the unnamed lake above the falls (Poia Lake). Poia Lake was noted by Elrod (1930) to contain only grayling. In contrast, Schultz, in 1941, noted:

> "The Dolly Varden or bull trout is abundant in the east side in the South Fork of Kennedy Creek and in other streams of the Saskatchewan River, but the survey did not take it in the Missouri system. No doubt the species is native to the Saskatchewan drainage as Jordan (1899) reported its occurrence in South Saskatchewan." (Morton 1961).

Rainbow trout, Arctic grayling, and cutthroat trout were stocked in Kennedy Creek between 1923 and 1938, and Poia Lake was stocked with Grayling numerous times in the 1920's and with cutthroat trout at least once, in 1938 (Morton 1961). Currently, bull trout are not known to occur in or upstream of Poia Lake, and the upper drainage is thought to be fishless.

Otatso Creek Drainage

Limited information exists for the fishery management activities in this drainage. The ranger log book at the Slide Lake patrol cabin contains several anecdotal accounts of bull trout seen and caught by anglers in Slide Lake and the reach of Otatso Creek upstream. A 1960 creel survey of Slide Lake recorded 53 anglers who caught 57 cutthroat, 17 bull trout, 15 rainbow trout and a single brown trout (*Salmo trutta*) (Morton 1961). The latter was probably a misidentified bull trout.

Lee Creek Drainage

Generally, the headwaters of Lee Creek were not extensively managed to improve the fishery, in part due to the absence of major headwater lakes and the small size of the streams. The headwaters of Lee Creek received plants of cutthroat and brook trout in 1937 and 1938 (Morton 1961).

Saint Mary River, Alberta, Canada

The Saint Mary River drainage is unique in southwest Alberta in that brown trout populations are not present upstream from Saint Mary Reservoir in Alberta, and brook trout are considered rare (Fitch 1997). While the prevalence of introduced

species, especially brook trout, was considered one of the threats that led to listing of bull trout in the Saint Mary - Belly River Recovery Unit (USFWS 1999), more recent information would indicate that in the Saint Mary River basin brook trout are not well-established in historically occupied bull trout waters (Mogen and Kaeding 2001). While interactions with nonnative species have not been thoroughly researched, introduced species are not currently considered to be a critical factor inhibiting bull trout recovery in the Saint Mary River drainage.

Belly River

Compared to the Saint Mary River drainage, there is much less historical information about the fishery status and management efforts to affect the fishery of the Belly River headwaters. The upper drainage is remote, with a lack of vehicle access.

Morton (1961) stated "nothing is known of the aquatic life" of Miche Wabun Lake, a 32 hectare (80 acre) lake in the headwaters of the North Fork Belly River. It is apparently fishless, as is the stream down to Miche Wabun Falls. There are no records of any fish being stocked in the North Fork Belly River in Glacier National Park (Morton 1961). Downstream from Miche Wabun Falls, the 2 kilometers (1.2 miles) of the North Fork Belly River in the United States are known to comprise a major portion of the bull trout spawning and rearing habitat for the Belly River core area (Clayton 2001).

Schultz reported only cutthroat trout, rainbow trout, and mountain whitefish in the Mokowanis River, the main western tributary to the Belly River, in 1941 (Morton 1961). Glenns and Cosley lakes historically have produced large-sized specimens of apparently native lake trout (McClung 1998). Both lakes were stocked with cutthroat trout in the 1920's and brook trout in the 1930's and 1940's. Some of the other headwater lakes upstream have been stocked with cutthroat or brook trout and contain reproducing populations. Several creel survey records cited by Morton (1961) from 1959 and 1960, (*e.g.*, Mokowanis River, Cosley Lake, and Elizabeth Lake) indicated bull trout presence, but were interpreted to be misidentification of brook trout or lake trout.

Brooks (1921) as cited in Morton (1961) stated the mainstem of the Belly River contained "blackspotted trout (cutthroat), whitefish, and no doubt other varieties of native species". However, Morton's (1961) fishery management review of the Belly River area disclosed no historical accounts of bull trout in the main Belly River. Glacier National Park records indicate that about 45,000 rainbow trout, 375,000 grayling, and 421,000 cutthroat were stocked in the Belly River between 1920 and 1938 (Morton 1961).

We have concluded that bull trout exist in the mainstem Belly River within Glacier National Park (probably historically as well as currently), upstream to Dawn Mist Falls, and in the Mokowanis River upstream to Gros Ventre Falls. Clayton (2001) provides contemporary documentation of the presence of bull trout to the base of each falls.

Fisheries Management Summary

By the 1960's, the decline of more than a half-century of intensive fish stocking in the United States waters of the Saint Mary and Belly Rivers signified a changing perspective on these fisheries. Unfortunately, little has been nor can be done, given limitations of current technology, to reverse the legacy of those practices. The vast majority of headwater lakes in the Saint Mary River and Belly River watersheds are likely to remain dominated by nonnative fishes.

Interviews with anglers who fished extensively in the Belly River and Saint Mary watersheds in Alberta during the 1930's through the 1960's, indicate they had a good understanding of migration, timing, and concentration areas and fished the spawning runs of migratory fish very effectively in Alberta (Fitch 1997). The entire province of Alberta adopted catch and release regulations for bull trout as of April 1, 1995. Currently, no legal harvest of bull trout occurs in the Saint Mary or Belly River drainages.

Angling is not perceived to have caused as significant an impact to bull trout in the Saint Mary drainage, as in the Belly and Waterton rivers. However, despite regulations prohibiting it, continuing instances of illegal harvest of bull trout have been noted. Several angler harvest violations were noted by biologists engaged in field

survey work in the Saint Mary River drainage in Montana in 1997 to 2001 (J. Mogen, USFWS, pers. comm., 2002b). Education of anglers and aggressive law enforcement will be required to reduce illegal take.

The Alberta Bull Trout Task Force (1995) conducted a *"No Black - Put It Back*" workshop in the city of Red Deer in 1995 as a means of developing a prioritized list of research and management needs for the restoration of bull trout in the Province. Highest priority was assigned to development and implementation of long-term monitoring protocols and index reaches, identification of seasonally important habitats for various life history types and life stages, and the development of a predictive model to identify harvestable surpluses of bull trout. Additionally, high priority fish and habitat management actions identified were habitat protection, evaluation of effects of forest management activities, development of cooperative watershed plans, andconsistency in fishing regulation strategies (Alberta Bull Trout Task Force 1995). Finally, the Task Force identified targeted information, communications, and education as critical for both the short- and long-term.

For the most part current fishery management practices and angler patterns are relatively benign in terms of the effects on bull trout recovery in the Saint Mary and Belly River watersheds. The larger fishery management issues will continue to be the stocking legacy.

Isolation and Habitat Fragmentation

There are two components inherent to the risk from environmental instability. First, is the likelihood of a catastrophic event occurring. Second, is the risk to bull trout if an event occurs. The Saint Mary River and Belly River drainages are at relatively high risk from environmental instability due to the harsh climate and unstable and relatively young glaciated geology. The area is subject to major runoff from heavy rainfall events, both in the spring as well as occasionally in winter. Extreme and rapid changes in weather are common. Much of the bull trout spawning and rearing habitat in the Saint Mary River and Belly River drainages is in watersheds with unstable soils and steep slopes. Extensive bedload aggradation combined with low flow conditions

can result in dewatering. Seasonal loss of surface flow is evident within aggraded reaches of several watersheds.

The primary drought risk to these watersheds appears to be more a result of possible major global climate change, rather than single events. Climate changes would likely affect bull trout rangewide. Due to the high elevation nature of most of the bull trout waters in the Saint Mary and Belly River drainages, the effects of drought in the Saint Mary - Belly River Recovery Unit are probably minimal. However, the gradual melting of the glaciers has an associated consequence in the gradual warming of water temperatures.

Rieman and McIntyre (1993) concluded that temperature is an important habitat variable for bull trout. Temperatures in excess of 15 degrees Celsius (59degrees Fahrenheit) are thought to limit bull trout distribution in many systems (Fraley and Shepard 1989; Brown 1992). Streams with headwater lakes typically have warmer water during summer and early fall. Lake Sherburne may become especially warm when it is drawn down in late summer, due to a lack of shade and solar heating of shallow mudflats. With the dewatering associated with agricultural practices, detrimentally warm water temperatures for bull trout become increasingly likely. Warm water temperature is particularly a concern downstream from the Saint Mary Diversion Dam in Montana, and in Canadian portions of the drainage further downstream. Water temperature concerns constitute an area of needed research.

A 1992 landslide event on Chief Mountain contributed thousands of tons of material to Jule Creek in the headwaters of Lee Creek. The 1992 slide produced long-term debris and sediment loading concerns, with uncertain effects on bull trout populations; a dramatic example of the unstable geology of this area. Under pristine conditions the effects would be short-term and populations severely affected could rapidly be recolonized from downstream. However, with the current fragmentation of bull trout populations in the Saint Mary and Belly river watersheds the likelihood of a natural event resulting in local extinction is increased.

The Saint Mary and Belly river watersheds are subject to flashy flow conditions, often caused by heavy rain (with or without snow) in the headwater areas.

Runoff events can move huge amounts of bedload material out of high gradient channels. Bedload movement is not necessarily a problem for bull trout, a species which evolved under these conditions. However, when habitat is fragmented, and/or when the natural conditions conflict with human wishes (*e.g.*, Divide Creek) the instability can be aggravated and the connectivity of the system and potential for recolonization are lost.

Historically, the risk to bull trout from fire was low. However, fragmented populations of bull trout remain and there may be an increasing likelihood of large-scale catastrophic fire in areas where suppression was actively maintained for the better part of the twentieth century.

Disruption of the migratory corridors (primarily irrigation diversions) has eliminated some of the potential connectivity for migratory bull trout from these watersheds. Little is known about the historical effects of population fragmentation on the current distribution of resident populations. If a local population is small enough, variations in survival can cause a declining population for a long enough period for it to be extirpated (Rieman and McIntyre 1993). Resident populations living upstream from barriers are subject to increased risk of extinction (Rieman and McIntyre 1993). Fragmentation is one of the most significant risk factors for bull trout in the Saint Mary River and Belly river drainages. Restoration of fluvial populations in each of the mainstems may be key to the long-term survival of bull trout in the Saint Mary - Belly River Recovery Unit.

Historically, bull trout may have moved freely among all of the creeks, rivers and lakes naturally inhabited by the species in the Saint Mary and Belly River drainages. Moreover, each of the three life-history forms–resident, fluvial, and adfluvial–would have been present in that historic, widespread population. Results of Mogen and Kaeding's (2001) study indicate that all three bull trout life-history forms remain in portions of the Saint Mary River drainage today, but the connectivity has been disrupted.

Mogen and Kaeding (2001) also concluded bull trout of the resident life-history form may occur in each of the tributaries they studied, but identifying those fish is problematic. Gust (2001) found that growth rates estimated from scale annuli during the first few years of life did not differ among bull trout captured from Boulder, Kennedy, upper and lower Otatso, and Lee creeks, even though the fish in upper Otatso Creek were confined there by barrier falls. Gust (2001) also found estimating growth and age of adult bull trout was difficult. Hence, even though resident fish may have slower growth as subadults and adults, they cannot be readily identified.

Mogen and Keading (2001) concluded that strict classification as to life history form is often subjective. For example, they describe one tagged bull trouttat was found during three consecutive winters in lower Kennedy Creek and concluded that although they might designate that fish as having a resident life history, the fish was also found at other times in the Saint Mary River, which would be characteristic of a fluvial life history. Other radio tagged bull trout passed through Lower Saint Mary Lake, and perhaps spent considerable time therein, on their way to winter habitats in the lower Saint Mary River, combining fluvial and adfluvial characteristics. Mogen and Kaeding (2001) conclude that the wide geographic distribution and diversity of habitats used by bull trout in the Saint Mary River drainage greatly increase the stability and likelihood of persistence of the overall bull trout population of the drainage (Rieman and McIntyre 1993).

Similarly, the fluvial fish in the Belly River system range from spawning areas below Miche Wabun Falls on the North Fork Belly River, through much of the mainstem Belly River, both upstream and downstream from the confluence with the North Fork (Clayton 1998). These radioed fish demonstrate the importance of connectivity to maintaining the population in the Belly River Core Area. There is less evidence of adfluvial fish in the Belly River system, but some local resident populations likely exist.

Rieman and Allendorf (2001) used a generalized, age-structured, simulation model to relate the effective population size (N_e) to adult numbers

under a range of life histories and other conditions characteristic of bull trout populations. They stated: "We conclude that cautious long-term management goals for bull trout populations should include an average of at least 1,000 adults spawning each year. Where local populations are too small, managers should seek to conserve a collection of interconnected populations that is at least large enough in total to meet this minimum." The collection of interconnected populations is defined as a core area. The core area represents our best approximation of a biologically functioning unit.

Rieman and Allendorf (2001) point out that few local bull trout populations (indeed, few core areas) support spawner numbers averaging 1000 ormore per year. They note that populations smaller than that should not be written off as lost causes, but rather, it should be recognized that those populations face greater threats associated with small population size and may require more aggressive management and more immediate attention to mitigate those threats (Rieman and Allendorf 2001).

The risk of core area and local population extirpation from isolation and fragmentation of habitat in the Saint Mary - Belly River Recovery Unit will generally increase if abundance or distribution of bull trout decline. The Saint Mary Diversion and other structures on the Saint Mary and Belly rivers in Canada were undoubtedly a major cause of migratory disruption. Fragmentation has continued at a finer scale, caused by habitat decline and nonnative species introductions. While bull trout are broadly distributed and may approach historical abundance in some local populations throughout United States portions of the Saint Mary - Belly River Recovery Unit, many populations appear to be at low enough levels to seriously reduce the chances of reproductive interaction or recolonization (*e.g.*, lower Saint Mary River). The threat from isolation and fragmentation is real and as more data is gathered it is anticipated we will gain a better understanding of how bull trout migrate and interact between patches (Rieman and McIntyre 1995).

ONGOING RECOVERY UNIT CONSERVATION MEASURES

Over most of the last decade significant planning efforts to restore and recover bull trout have been initiated in Montana and Alberta, Canada, and some on-the-ground activities have been implemented that were specifically designed to benefit bull trout and other native salmonids within the Saint Mary - Belly River Recovery Unit. Ultimately, the measure by which these efforts should be judged is the degree to which they have produced positive response in the numbers and security of local bull trout populations. However, because most of these efforts are relatively young, and would not be expected to produce measurable population response for perhaps several bull trout generations, it is premature to judge the success of most of those programs. Following is a brief summary of the existing and ongoing conservation activities, by jurisdiction.

Blackfeet Nation

The Blackfeet Nation has a compelling interest in the fate of bull trout in the Saint Mary - Belly River Recovery Unit. Recovery of bull trout is important to them, as a people, and they have been involved in the Federal recovery planning process. Several Tribal representatives were involved in the working group that wrote the original status report (Fredenberg 1996). Tribal representatives have maintained an active interest in the ongoing section 7 consultation with the U.S. Bureau of Reclamation on the Saint Mary diversion and the Tribe has been instrumental in supporting the scientific research which has developed much of the recent baseline information on bull trout in the Saint Mary watershed (Mogen and Kaeding 2002). The Blackfeet Tribe adopted a new fishing regulation, effective April 1, 2000, that makes it "unlawful to take or be in possession of bull trout". The Tribe is also aware of the need to consider tightening regulatory control over commercial fishermen who work gill nets for lake whitefish on Saint Mary Lake, taking bull trout incidentally. The Blackfeet Nation also has a developing conservation easement program, promoted in part by the U.S. Fish and Wildlife Service Partners program, to protect some of their sensitive lands.

Federal Activities

Aside from the standard land management, water management, and Endangered Species Act guidelines that apply to Federal actions (see Chapter 1), there have been several significant Federal efforts with specific implications for bull trout in the Saint Mary - Belly River Recovery Unit.

The U.S. Fish and Wildlife Service has established several staff positions in Montana, under the Partners for Fish and Wildlife Program. Most of their effort has been directed at developing partnership opportunities and directing Federal funds toward cooperative habitat restoration, water development, and easement programs to benefit native fish and wildlife in prescribed focus areas. The Saint Mary River drainage in Montana is in the East Front Rocky Mountain focus area (USFWS 2000).

In 1964, Glacier National Park adopted an interim fishery management plan. Included were guidelines that dictated only native species would be stocked in the Flathead drainage west of the Continental Divide, no more brook trout would be planted anywhere in Glacier National Park, rainbow trout and Arctic grayling stocking would be limited only to suitable waters east of the Continental Divide with established populations, and lake trout stocking would be limited to Waterton and Saint Mary lakes.

Since 1964, Glacier National Park has steadily reduced fish stocking efforts and the last fish plant in Glacier National Park occurred in 1972. Fishing regulations have been gradually adjusted to protect native species. Unfortunately, funds have never been available to conduct extensive fishery management surveys and while active management to enhance recreational angling has largely ceased, effects on native species from the legacy of earlier efforts have continued to erode native species distribution and abundance. Due to the lack of funding for evaluation, much of the impact is undocumented, though some research studies have documented the population trend of bull trout (Mogen and Kaeding 2001, Fredenberg *in press*).

Currently, Glacier National Park follows National Park Service guidance. That guidance includes an emphasis on understanding, maintaining, restoring, and protecting the inherent integrity of the natural resources, processes, systems, and values of Glacier National Park; with emphasis on native plants, animals, and communities. The National Park Service maintains a nonintervention policy on natural biological or physical processes (*e.g.*, fire suppression) with the caveat that "Biological or physical processes altered in the past by human activities may need active management to be restored." (National Park Service 2001).

Specifically, National Park Service direction includes reestablishing natural functions and processes in human-disturbed components of natural ecosystems, including removal or suppression of nonnative species and recovery of species like bull trout that are listed under the Endangered Species Act. Specific guidance, under section 4.4.4 of the National Park Service Management Policies (National Park Service 2001), says: "Exotic species will not be allowed to displace native species if displacement can be prevented." Under section 4.4.4.2 it is further noted that: "exotic plant and animal species will be managed - up to and including eradication". National Park Service guidance further relates that "For species determined to be exotic and where management appears to be feasible and effective, superintendents should (1) evaluate the species' current or potential impact on park resources; (2) develop and implement exotic species management plans according to established planning procedures; (3) consult as appropriate, with Federal and State agencies; and (4) invite public review and comment, where appropriate (National Park Service 2001).

The U.S. Fish and Wildlife Service is currently engaged in informal consultation with U.S. Bureau of Reclamation as it pertains to the effect of the operations of the U.S. Bureau of Reclamation irrigation project on threatened bull trout in the Saint Mary River drainage. Three main issues have emerged. First is fish passage over the Saint Mary Diversion Dam downstream from Lower Saint Mary Lake, which has the potential to disrupt the migratory corridor between the Saint Mary River and upstream spawning locations, particularly Boulder Creek. Second is the issue of maintaining instream flow in the lower channel of

Swiftcurrent Creek, which is typically dewatered for most of the winter, and where adult bull trout have been stranded in the past. The third issue is the ongoing entrainment of bull trout in the unscreened Saint Mary Canal system. Additional consideration of the impacts of the irrigation project on water temperatures may be warranted as well.

The U.S. Bureau of Reclamation has funded studies for collecting data on bull trout distribution and abundance in the Saint Mary basin since 1997 (see Mogen and Kaeding 2001). The research is being used to identify and analyze impacts of the Saint Mary facilities of the Milk River Irrigation Project and to implement actions to reduce those impacts. In the fall of 2001, the timing of the cessation of water releases from Sherburne Dam was altered in an attempt to reduce the attractiveness of Swiftcurrent Creek to migrating bull trout. The stream reach was then electrofished, and stranded bull trout and westslope cutthroat trout were salvaged and returned to the active channel downstream.

An experimental electric barrier has been purchased by the U.S. Bureau of Reclamation to reduce entrainment into the Saint Mary Canal, and is scheduled for installation at the headgates in the fall of 2002. An entrainment study is being initiated to determine the extent of fish losses, both pre- and post- barrier installation, and to determine efficiency of the electric barrier. Interim fish passage designs are being considered, to provide fish passage over Saint Mary Diversion Dam until a long-term solution is developed. Studies have also been initiated to determine the most cost-effective method of permanently modifying project facilities to provide winter flows in Swiftcurrent Creek, and to address the issues of passage and entrainment at the diversion.

Alberta, Canada, Government Activities

Bull trout remain widely distributed along the east slopes of the Rocky Mountains in Alberta (Brewin and Brewin 1997), though they have declined in many areas due to causes similar to those in the United States (Post and Johnston 2002). The Province of Alberta has dedicated multiple resources to the protection of bull trout, including convening a bull trout task force to develop

ecommendations for research and management efforts (Berry 1994, Alberta Bull Trout Task Force 1995). Alberta Trout Unlimited has convened two major scientific conferences, with published proceedings from each that have greatly broadened the base of scientific knowledge on bull trout (Mackay *et al.* 1997, Brewin *et al.* 2001). Combined government and private efforts resulted in the fish being officially recognized as the Provincial Fish of Alberta, and that collaboration has been key in supporting an aggressive and successful public education and marketing campaign which has improved awareness and appreciation of the species in the Province (Norris *et al.* 2001).

Overfishing has been often identified as the single biggest factor leading to bull trout population decline in Alberta (Berry 1994, Walty and Smith 1997), and some overfished populations have achieved dramatic recovery, most notably in Lower Kananaskis Lake (Mushens and Post 2000). The Provincial version of a bull trout recovery plan includes a goal of recovering and sustaining bull trout with a clear policy statement that conservation is the highest priority, followed by catch-and-release recreational angling opportunity second, and limited harvest where it can be accommodated third (Berry 1994). Other factors that have caused the decline of bull trout in Alberta include those identified as threats to the Saint Mary - Belly River Recovery Unit, especially fragmentation and degradation of habitat, and the proliferation of nonnative species (McCart 1997). In general, Alberta fishery managers are optimistic about recovery of many, but not all bull trout populations in the Province (McCart 1997).

State of Montana

In 1993, the Governor of Montana appointed the Bull Trout Restoration Team to produce a plan that maintains, protects, and increases bull trout populations. The team appointed a Montana Bull Trout Scientific Group to provide the restoration planning effort with technical expertise.

The scientific group wrote 11 basin-specific status reports, including a draft for the Saint Mary drainage, and 3 peer-reviewed technical papers. A restoration plan that defined and identified strategies for ensuring the long-term persistence of bull trout in Montana was finalized in June 2000 (MBTRT 2000). The plan

focused activities on 12 restoration and conservation areas and was designed to complement and be consistent with the Federal recovery plan. Because there was no abiding State interest in the Saint Mary and Belly River watersheds, which lie entirely in either Glacier National Park or the Blackfeet Nation in Montana, and flow north into Canada, the Montana Bull Trout Restoration Team elected not to include analysis of the Saint Mary - Belly River Recovery Unit in their final restoration plan. The State of Montana remains interested in recovery issues in the Saint Mary - Belly River Recovery Unit, but maintains no direct involvement in the planning process.